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BLUEBERRY AND HUCKLEBERRY INSECTS

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A Thesis

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DOCTOR OF PHILOSOPHY

L. C.

BY

CLARENCE RITCHIE PHIPPS

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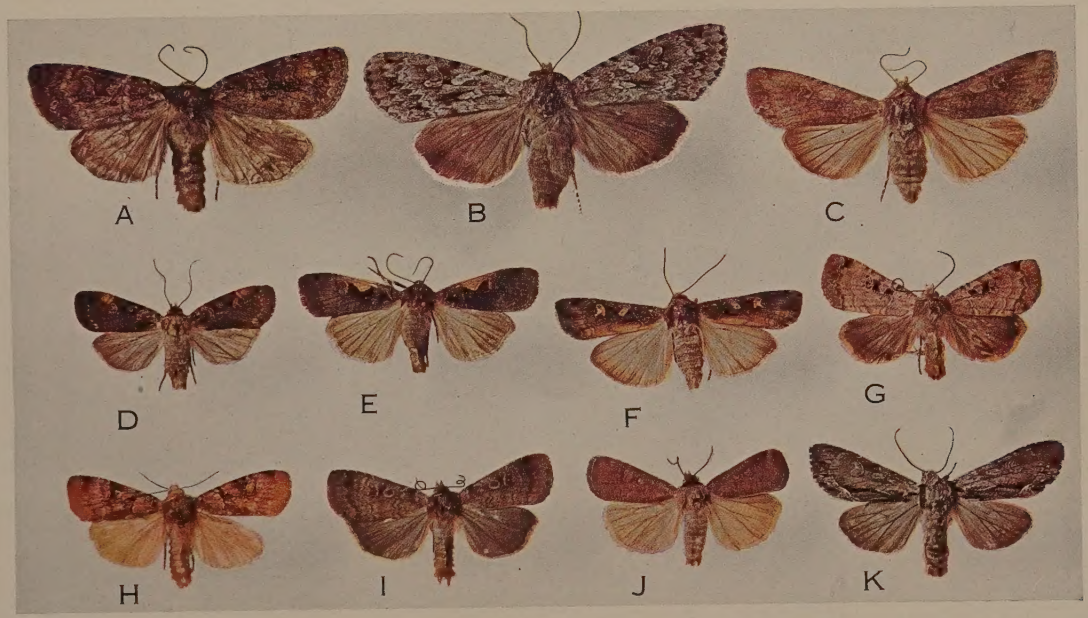

OWLET-MOTHS, ADULTS OF BLUEBERRY CUTWORMS

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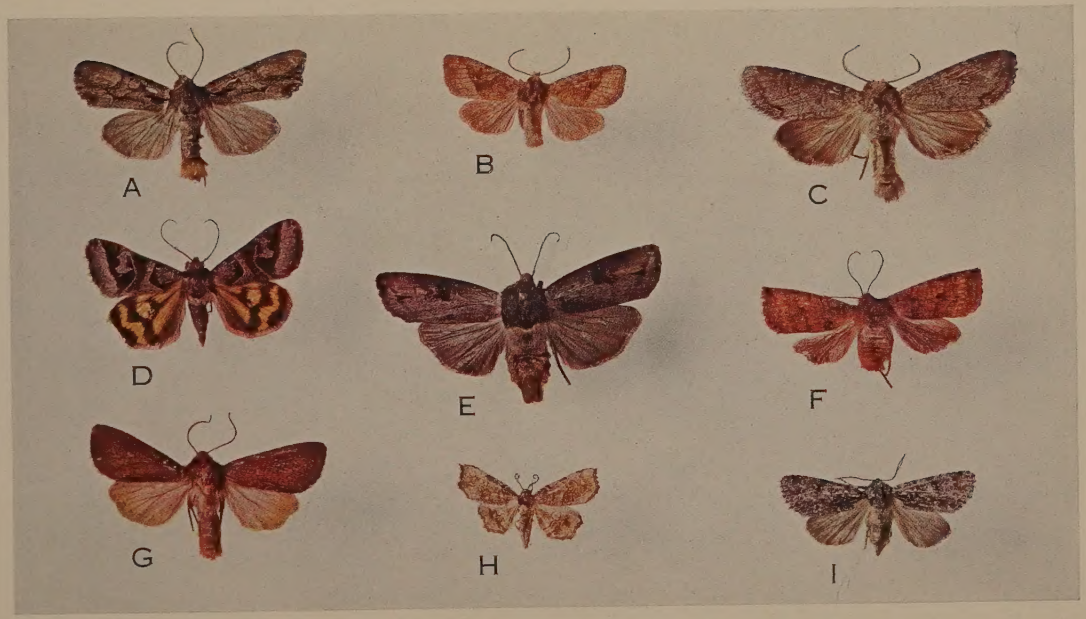
FIG. A, *Lycophotia astricta;* B, *L. occulta;* C, *L. saucia;* D, *Agrotis bicarnea;* E, *A. c-nigrum;* F, *A. fennica;* G, *A. normaniana;* H, *A. oblata;* I, *A. phyllophora;* J, *Lampra brunneicollis;* K, *Hyppa xylinoides.*



OWLET-MOTHS, ADULTS OF BLUEBERRY CUTWORMS

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FIG. ~~22~~ A, *Polia subjuncta;* B, *P. lorea;* C, *P. purpurissata;* D, *Drasteria graphica atlantica;* E, *Calocampa cineritia;* F, *Scopelosoma walkeri;* G, *Ceramica picta;* H, *Pangrapta decoralis;* I, *Acronycta distans.*

BULLETIN 356

BLUEBERRY AND HUCKLEBERRY INSECTS

By C. R. Phipps

INTRODUCTION

This paper[1] is based upon a five years' study of the insects which feed upon, or otherwise affect, the various species of blueberry and huckleberry occurring in Maine. It also includes records of some insects collected by the writer on these plants in Massachusetts. In addition it attempts to list those insects which other investigators have reported as destructive to this group of plants. For convenience the mites which infest these plants are also included.

During the course of this study the writer has taken, on blueberry and huckleberry, some 80 different species of insects, previously unrecorded on them. Many of these insects cause considerable damage at present, especially the cutworms, loopers, sawflies, and a species of thrips new to science.

In connection with the pollination studies a list of about 40 species of flower visitors is noted. These studies, while preliminary in nature, show conclusively that many insects visit the flowers and collect pollen from them. That such insects exert a marked influence in pollination is evidenced by the fact that their exclusion by means of cages decreased yields strikingly.

A number of new parasite records have been established including three new species of Hymenoptera and one of Diptera.

Much time has been spent in the field each season in various blueberry districts. Night collecting, in particular, has yielded many interesting records. By that means some 25 species of cutworms, as well as many loopers, were taken feeding on the plants. These were subsequently reared to maturity. The operation of a light trap has also been of value in furnishing data on the flight of some of the cutworm moths.

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[1]Also presented to the Faculty of the Graduate School of Cornell University, June, 1930, as a thesis in partial fulfillment of the requirements for the degree of Doctor of Philosophy. The title of the thesis was "A Biological and Ecological Study of the Insects Affecting the Blueberry and Huckleberry".

From an entomological viewpoint slight attention has heretofore been accorded the blueberry as compared with other fruits. This neglect has, in a large measure, been due to the fact that until recently blueberries have been considered a wild crop, receiving little or no cultural attention. Accordingly with the exception of Kaltenbach's (1874)[2] list of insects occurring on these plants, and Woods' (1915) *Blueberry Insects in Maine,* no extended list or study has been published.

IMPORTANCE

Blueberries constitute one of the most valuable canning crops in Maine. Known popularly as "the million dollar industry", it is exceeded in value only by potatoes, hay, fuel wood, oats, apples, and sometimes sweet corn. It is to a large extent concentrated in Washington County, although a considerable acreage is devoted to it in Hancock County as well as limited areas in Knox, Lincoln, York, and Cumberland Counties. Some 30 or 40 factories handle the canned part of the crop which is said to constitute about 90 per cent of all the blueberries canned in the world. In addition a considerable quantity is shipped to Boston and other cities in the form of fresh fruit.

It is of interest to note that blueberries are grown in 30 states in this country, in Alaska and various parts of Canada, and in foreign countries. According to a recent questionnaire they are of economic importance in Canada and Alaska and, in the United States, in Alabama, Florida, Indiana, Maine, Michigan, Minnesota, Mississippi, New Hampshire, New Jersey, North Carolina, Rhode Island, Tennessee, Vermont, Washington, and Wisconsin. The commercial canning of this fruit, however, is restricted to Maine, Michigan, Minnesota, Mississippi, and parts of Canada. In Europe blueberries occur extensively in the wild state. In England it is known as "Bilberry", "Blaeberry", or "Whortleberry"; in France as "Aiselle", "Aurelle", "Myrtille", "Myrtilles des bois", or "Bluete"; in Sweden as "Blabar"; in Lapland as "Zirre" or "Zerre"; in Germany as "Blaubeere",

[2]Reference to Literature Cited is made by date of publication and name of author, page 219.

"Bickbeere", "Heidelbeere", "Meydelbeere"; in Italy as "Mirtillo"; in Russia as "Goluble", "Pjaniza", "Tichernizа"; and in other countries under various local names.

SOME FACTORS INFLUENCING INSECT ABUNDANCE IN BLUEBERRY FIELDS

The conditions affecting the relationship existing between the blueberry and its insect pests are particularly significant, under Maine conditions, due to the present methods of production. In order to make the discussion clear it is necessary that the reader know something of the type of land upon which the blueberries are produced as well as something of the cultural methods employed.

The industry[3] is, to a large extent, concentrated in Washington County, although a considerable acreage is devoted to it in Hancock County as well as limited areas in Knox, Lincoln, and Cumberland Counties. At present commercial operations are largely confined to a strip of land extending along the coast and rarely running back from it more than 20 miles.

Both the blueberry and huckleberry require a distinctly acid soil such as one finds rather generally throughout the State. Blueberries are produced on two entirely different types of land. The first of these, and by far the greater area, consists of the so-called blueberry "Barrens". There are over 250,000 acres of this land (Fig. 17) in Washington County alone. Formerly in timber, it is for the most part rough and dotted here and there with boulders deposited by the glacial drift many centuries ago. In many instances fires swept over large areas soon after the timber was cut off and, as a result, the blueberry plants, which had previously been held in check, spread rapidly in the presence of adequate sunlight. This soil is often thin and sandy so that in the absence of any care other than occasional burning it tends to run out. Consequently the berries become smaller in size and the yields decrease after cropping has been carried on for a period of years.

The second and more productive type of land consists of pastures or fields which, in many cases, have recently been under

[3]See Maine Agr. Expt. Sta. Bul. No. 351 entitled "An Economic Study of 239 Blueberry Farms in Washington and Hancock Counties, Maine".

cultivation. Such recently cultivated land is more productive, more readily kept free of competing bushes and weeds, and it is likewise more easily rid of disease and insect pests.

The low sweet blueberry[4] is by far the most abundant species in Maine. It is also the most desirable commercial berry in this State. The sour-top or velvet-leaf blueberry[5] also occurs in consierable abundance throughout the State. A third low species[6] occurs in the State but not in abundance. The fruit of the first two species may vary in color from whitish through light and dark blues to black.[7] Two species of high bush blueberry[8] occur in Maine. The former is quite abundant in York County in the vicinity of Sanford and East Lebanon where it receives some commercial attention. The common huckleberry[9] also occurs throughout the State. Because of its large seeds and black fruit the huckleberry as it occurs in blueberry fields is treated as a weed and destroyed.

Mixed Stands of Blueberry and Other Plants

In addition to the plants referred to above, there are many others which grow extensively in the commercial fields and compete with the blueberry. Varying with local conditions some of the most objectionable and abundant are alder[10], bayberry[11], birch (gray)[12], birch (white)[13], bunchberry[14], cherry (bird or pin)[15],

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[4]*Vaccinium pennsylvanicum* Lam.

[5]*Vaccinium canadense* Kalm.

In these and the subsequent plant references the nomenclature of Gray's New Manual of Botany, Seventh Edition, has been followed.

[6]*Vaccinium vacillans* Kalm.

[7]The white fruits may represent either *V. pennsylvanicum* var. *leucocarpum* Deane or *V. canadense* forma *chiococcum* Deane. Those plants of *V. pennsylvanicum* bearing black fruits are known as *V. pennsylvanicum* var. *nigrum* Wood.

[8]*Vaccinium corymbosum* Linn. and *V. atrococcum* (Gray).

[9]*Gaylussacia baccata* C. Koch.

[10]*Alnus incana* (L.) Moench.

[11]*Myrica caroliniensis* Mill.

[12]*Betula populifolia* Marsh.

[13]*Betula alba* var. *papyrifera* Marsh.

[14]*Cornus canadensis* L.

[15]*Prunus pennsylvanica* L.

cherry (choke)[16], fern (brake) [17], fern (hay-scented)[18], hazelnut[19], lambkill[20], meadow-sweet[21], poplar[22], service berry[23], steeple bush[24], and sweet fern[25]. As a result of this mixed stand many insects which normally infest other plants will, in years of abundance, spread to the blueberry, and not infrequently they defoliate hundreds of acres.

The writer has witnessed several outbreaks of this type, notably one by the black army cutworm[26] in 1925. The cutworms were present throughout the State in such numbers that they stripped the fruit buds from thousands of acres of blueberry plants thereby causing an almost complete crop failure. The favorite food plants of this cutworm belong to the Rose Family which is well represented in most of the blueberry fields. This fact may well account for the concentration of this cutworm in the blueberry fields during seasons of abundance. Incidentally this was the first known record of cutworm injury in Maine blueberry fields. However, our investigations have since shown that local outbreaks occur practically every year and that in addition to the black army cutworm at least 24 other cutworms feed upon the blueberry in Maine. Because of their habit of working at night these cutworms were evidently unnoticed formerly, the stripped areas being commonly regarded by the growers as the result of frosts at blossoming time.

The chain-dotted measuring worm[27] is another insect which has been exceedingly destructive upon occasion. The presence of its preferred food plant, sweet fern, in the fields undoubtedly has caused many outbreaks in blueberry fields. The writer has observed the egg laying habits of the moths on a number of occa-

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[16] *Prunus virginiana* L.
[17] *Pteris aquilina* L.
[18] *Dicksonia punctilobula* (Michx.) Gray.
[19] *Corylus* sp.
[20] *Kalmia angustifolia* L.
[21] *Spiraea latifolia* Borkh.
[22] *Populus* sp.
[23] *Amelanchier spicata* (Lam.)
[24] *Spiraea tomentosa* L.
[25] *Myrica asplenifolia* L.
[26] *Agrotis fennica* Tausch.
[27] *Cingilia catenaria.*

sions. The eggs are deposited singly in the fall on the undersides of the leaves of sweet fern preferably, although a species of brome grass[28] is also utilized.

A species of thrips described by Mr. A. C. Morgan as a new species[29] is likewise of great importance in many fields and it quite possibly has spread to the blueberry from sweet fern or whorled loosestrife[30] which plants it also frequents. If the blueberry were raised in pure stands, surrounded more or less by cleared fields as in the case of other fruits, it is probable that such attacks would never occur.

Periodic Burning

A second, and perhaps the most important, factor governing blueberry insect abundance is concerned with the periodic burning over of the fields. This is simply a method of pruning in order to renew the plants and thereby to obtain more and better fruit. If the blueberry plants are not renewed by this or some other method the yields become markedly less and the size and quality of the fruit suffers. Burning is usually done in the spring in order to avoid fire hazard as well as the injury to the roots which later and deeper burning would occasion. It is customary, in the fall, to spread hay at the rate of about a ton to the acre on those portions of the field which are to be burned over the following spring. This practice insures a more even and thorough burn but, unfortunately, provides a protection for overwintering insects. The better fields are burned over once in three years.

Burning has certain cultural advantages. At present it is a practical and economical method of renewing the plants. It likewise apparently tends to hold in check certain fungous leaf-spot diseases. From the entomological viewpoint it has both advantages and disadvantages. Burning is beneficial, from the insect standpoint, in that it periodically checks the increase of certain insects such as the blueberry fleabeetle[31], which passes the winter on the ground in the egg stage, and the spittle bug[32], whose eggs

[28] *Bromus ciliatus.*
[29] *Frankliniella vaccinii.*
[30] *Lysimachia quadrifolia.*
[31] *Altica torquata.*
[32] *Clastoptera proteus.*

are present in the blueberry stems at the time of burning. On the other hand there is undoubtedly a positive correlation between burning and insect outbreaks. For example, cutworm outbreaks are of outstanding severity in "new burn" fields, that is, those burned over during the spring of the preceding season, and the writer has repeatedly observed such attacks. In areas where the blueberries are in fields other than new burn they have not been subject to such injury. It is evident then that the moths are attracted to the "new burn" fields, for the purpose of egg-laying, presumably by the rank, succulent growth of the blueberry and other plants. In a similar way outbreaks of thrips, geometers, sawfly larvae, and other insects are usually more pronounced in fields which have recently been burned over. Lugger (1896) reported a widespread outbreak of the black army cutworm in Minnesota and made the following statement concerning it: "All of the foliage since the great fire of 1893 seemed to be to the taste of these worms."

Proximity of Food and Shelter

A third factor of considerable importance is the proximity of woods or fields and swamps covered with dense bushes. Thus many insects are afforded unusual shelter and food conditions. As an example the first outbreak of the chain-dotted measuring worm which came to our attention had its inception in a piece of swampy land which was heavily populated with the preferred food plant, sweet fern. The larvae were present by the millions so that after defoliating nearly every plant in the swamp they made their way across a pasture and thence into a large blueberry field. Here their progress was stopped promptly by spraying a strip about two yards wide along the side of the field which was in the line of march.

On the other hand a variety of vegetation in any given locality may prove an advantage during seasons when certain insects are not present in such excessive numbers as to strip their favorite food plants. Under such circumstances the blueberry would escape attack.

POLLINATION STUDIES

It often happens that there is very little correlation between a heavy bloom and a subsequent crop of fruit. Dr. A. C. Hildreth, formerly of the Department of Biology of the Maine Agricultural Experiment Station, suggested the need for further information regarding the role played by insects in blueberry pollination. Lovell (1920, p. 272) says, "The blueberries and huckleberries have pendulous, urn-shaped flowers which are largely visited by bees." He also states (1926, p. 72) that blueberries and huckleberries yield an amber-colored honey of good quality. Moreover he declares that in certain localities beekeeping is largely dependent upon the presence of blueberry and huckleberry plants.

Since honeybees and other insects collect nectar from these plants it is logical to suppose that they would be likely to transfer pollen from plant to plant. Coville (1910, p. 78) makes the following statement regarding the part played by insects in the pollination of the blueberry: "Ordinarily pollination is effected by some insect which, pushing its way into the orifice of the corolla from beneath in search of nectar, releases the pollen. In continuing its quest for nectar the insect brushes against the stigma with some portion of its body, which is covered with pollen, either from the same flower or from some other flower previously visited." Because of the need of more specific information under Maine conditions some preliminary work on this problem was carried on during the 1928 and 1929 seasons. Since some of the findings are of interest the writer is including them here.

Two different lines of investigation were pursued, the first of these being an attempt to list some of the more common blossom visitors, and to ascertain whether or not they collect blueberry pollen. Fortunately, blueberry pollen is quite unlike the pollen of most other plants which are in bloom at that particular time (from the middle of May until early June). The pollen grains occur in the so-called tetrad condition; that is, each grain is divided into four equal quadrants, the divisions being indicated by surface lines or sutures. Unlike some other pollen of this type the grains do not subsequently divide into four separate pieces. During the blooming periods of 1928 and 1929 a number of bees, wasps, and flies were collected on blueberry blossoms.

Subsequent examination revealed pollen of the kind referred to above as peculiar to the blueberry on the legs and thoraces of many of these insects including bumblebees and honeybees. It is a well established fact that bees normally frequent a certain species of flower exclusively until its blossoming period is over, then visit flowers of a later blooming plant, and so on. Consequently it is safe to assume that these were not merely chance collections of blueberry pollen. A list of the bees, wasps, and flies taken on blueberry blossoms in Maine during 1928 and 1929 follows:

DIPTERA. *Bombylius major* L., *B. pygamaeus* Fab., *Calliphora vomitoria,* var. *nigribarba* Shannon, *Dalmannia nigriceps* Lw., *Epalpus signiferus* Wlk., *Eristalis arbustorum* L., *E. bastardi* Macq., *E. compactus* Wlk., *Eurosta latifrons* Lw., *Leptis mystaceus* Macq., *Lucilia* sp., *Melanostoma mellinum* L., *Myopa clausa* Lw., *Sericomyia bifasciata* Williston, *S. chrysotoxoides* Macq., *S. sexfasciata* Wlk., *Sphaerophora scripta* L., *Winthemia quadripustulata* Fab. of authors.

HYMENOPTERA. *Andrena* sp., *A. vicina* Smith, *A. ziziae* Robertson, *Apis mellifera* L., *Augochlora confusa* Robt., *Bombus impatiens* Cress., *B. perplexus* Cress., *B. ternarius* Say, *B. terricola* Kirby, *Colletes productus* Robt., *Epeolus* sp., *Halictus coriaceus* Smith, *H. pilosus* Smith, *H. provancheri* D.T., *Macropis morsei* Robt., *Nomada* sp., *Psithyrus fernaldae* Franklin, *Sphecodes* sp., *Vespula norvegica* (Fab.), *V. maculata* (L.)

The Diptera were determined by Dr. J. M. Aldrich or Mr. C. T. Green, Bureau of Entomology, Washington, D. C. The Hymenoptera were determined by Miss Grace Sandhouse, Bureau of Entomology, Washington, D. C.

The object of the second line of investigation was to determine how important a factor insects actually are in promoting pollination. Just prior to blossoming time in 1929 a large cage covered with 20 mesh copper wire screening was set up in a blueberry field in Hancock County. The owner of the field stated that he kept several hives of bees because he was certain that his bees aided in pollination and that the blueberry honey which they produced was of especially fine quality. The cage, about a yard and a half square by 40 inches in height, was placed within a few yards of the hives. At blooming time the plants within the cage blossomed heavily as did the rest of the clon (group of cultivated plants composed of individuals propagated vegetatively from a single original stock) which was outside. Throughout the

blossoming period the honeybees and bumblebees were present in great numbers on the blueberry blossoms outside the cage. Examination a few days after petal fall showed an apparently good set of fruit both within and without the cage. As a matter of fact many fruits did set but by picking time not a single berry was found in the cage, while a pint or more (about 1000 berries) was gathered on an equal area outside the cage. This experiment indicated that the wind played relatively no role in fertilization, and that the exclusion of the honeybees and other insects was the cause of the lack of set. Bagging experiments carried on by Doctor Hildreth gave essentially identical results. It should be stated here that while the larger insects were excluded it would not be safe to say that none of the smaller forms, such as thrips or ants, had gained entrance.

In conclusion, then, the investigations thus far have shown: (1) That various species of insects, especially honeybees, bumblebees, and other bees collect blueberry pollen. (2) That such insects undoubtedly exert a marked influence in blueberry pollination since their exclusion affects yields so strikingly.

LIFE HISTORIES OF MAINE SPECIES OF BLUEBERRY INSECTS WITH SUGGESTIONS FOR CONTROL

The following discussion is concerned with those species collected and studied during the course of this investigation. Only such insects as were actually observed feeding on blueberry or huckleberry are included here. While a few of these insects had previously been reported as blueberry pests by other workers some 80 different species are here noted for the first time as attacking these plants. Of course many of these insects, newly recorded here as blueberry pests, have long been known to occur over a wide geographic range; and certain of their foodplants, exclusive of blueberry and huckleberry, have been listed by other workers. Some of these newly recorded species have been among the most destructive blueberry insects prevalent in Maine for several years. In fact it is interesting to note that such economic forms as the blueberry thrips, and certain cutworms, geometers, and sawflies were apparently so scarce 15 to 18 years ago that they are not even mentioned in Woods' *Blueberry Insects in*

Maine. On the other hand, with the exception of the blueberry maggot, the insects which were important then are not considered serious now. The foregoing observations serve to illustrate the fact that a given species of insect may vary in abundance from time to time.

ORTHOPTERA—Grasshoppers and Their Relatives

TETTIGONIIDAE—The Katydids

Phaneroptera curvicauda borealis (Hebard). This insect was taken feeding on blueberry leaves in North Gray on July 1, 1929. Several specimens were subsequently reared from small nymphs to adults, the adult stage being attained about mid-August. During this period they were fed exclusively on blueberry (*Vaccinium canadense, V. corymbosum,* and *V. pennsylvanicum*) which was readily accepted. The feeding is of an irregular type, the midrib and principal veins not usually being consumed.

Phaneroptera pistillata (Brunner). Adults of this katydid were taken on blueberry in Cherryfield on August 23, 1929. The habits of this insect are similar to those of the preceding species. Both forms feed upon a considerable number of herbaceous plants and apparently do not occur in sufficient numbers to affect the blueberry seriously.

GRYLLIDAE—The Crickets

Nemobius fasciatus fasciatus (De Geer). This small field-cricket occurs in considerable numbers in the blueberry fields under Maine conditions and it is probably of some economic importance. Unlike most of the other Orthoptera noted here, this insect feeds upon the berries especially (Fig. 18, B) and consumes the pulp and skin as well as the seeds. One specimen subsisted on the fruit alone from August 24, 1929, until September 12 when it was killed and pinned. As it happened the one in question was a female which laid four long, slender, white eggs during its captivity. Many partly eaten berries are found in the fields at picking time and it is likely that this and other crickets are responsible for a considerable part of this injury.

Oecanthus niveus De Geer, the Snowy Tree Cricket. This well known economic insect is distributed throughout North America and Cuba. Its injury is caused, not by feeding, but by its egg-laying punctures on the branches of apple, crataegus, elm, raspberry, willow, and other plants. One specimen (adult female) was taken on a high bush blueberry plant *(Vaccinium corymbosum)* near Princeton, Massachusetts, on August 8, 1929.

LOCUSTIDAE—The Grasshoppers

Hippiscus apiculatus Harr. Our records are based on specimens taken on blueberry at Machias, Maine, on June 13, 1929. This is probably not an important blueberry pest.

Melanoplus bivittatus (Say). Adults were collected at North Sedgwick, Maine, on August 22, 1929. The insect, which commonly feeds upon rank, succulent growth, eats the leaves and fruit of the common species of blueberry. It is distributed from the Atlantic to the Pacific, and from Hudson Bay to North Carolina.

Dissosteira carolina (Linn.) Like the preceding species this grasshopper occurs throughout the United States and Canada. It feeds upon the common varieties of blueberry as well as upon many other plants. Specimens were taken attacking blueberry plants at Harrington, Maine, on August 23, 1929.

Chloealtis conspersa Harr. This common grasshopper occurs in the United States from Maine to the Rocky Mountains. It feeds on blueberry leaves and was collected at North Gray, Maine, on June 24, 1929. The species is said to live in or near woodland. Our specimens were taken in extensive blueberry fields which are surrounded by hundreds of acres of flat sandy plains on which scattered pine is the principal tree growth.

Nomotettix cristatus cristatus (Scudder). Specimens were taken on blueberry foliage, as in the preceding case, at North Gray, Maine, on June 24, 1929. The insect occurs in Canada and in the United States from Maine to Indiana as recorded by Blatchley (1920, p. 157).

Chorthippus (Stenobothrus) curtipennis (Harr.). This prairie or marsh species likewise inhabits the flat blueberry plains where it was taken feeding on blueberry leaves on July 24, 1929. It has been recorded from Maine to Indiana.

Melanoplus keeleri luridus (Dodge). Unlike the majority of the short horned grasshoppers observed by the writer, this species eats blueberry fruit as readily as the foliage. Specimens were collected on blueberry at North Sedgwick, Maine, on August 22, 1929.

Scirtettica marmorata (Harr.). This inhabitant of sandy places was taken on the flat, sandy blueberry plains of southern Maine on July 24, 1929. It feeds upon the leaves of blueberry and many other plants.

Camnula pellucida (Scudder). Recorded as a prairie or woodland species, this grasshopper is found in Canada and in the United States from Maine to Indiana and westward. During 1929 the writer took it on blueberry at North Gray on July 24, at North Sedgwick on August 22, at Harrington on August 23, and again at North Sedgwick on blueberry plants on the night of August 23.

The writer has taken grasshoppers of several species on blueberry plants at night, the insects either feeding or apparently resting.

HEMIPTERA—The True Bugs

PENTATOMIDAE—The Stink Bugs

Coenus delius (Say). A number of brown stink bugs of this species were found feeding on ripe blueberry fruit *(Vaccinium pennsylvanicum)* at North Sedgwick on August 22, 1929. Judging from our observations in one field, this and other representatives of this family are largely responsible for the many punctured and partly shriveled berries which are to be found at picking time. Such fruits are quite different from the soft, mushy, maggot-infested berries with red, broken down pulp. The insect is recorded from Canada and from the United States where it is found from Maine to Colorado and south to Texas.

Banasa dimidiata (Say). The writer collected a number of the adults and nymphs in 1929. They were found attacking high bush blueberry *(Vaccinium corymbosum)* at Princeton, Massachusetts, on August 7, 1929, and at East Wareham, Massachusetts, on August 9, 1929. On August 9 a number of the adults were collected on huckleberry fruit *(Gaylussacia baccata)* at Bourne, Massachusetts. On Auugst 7 others were taken on huckleberry *(Gaylussacia baccata* var. *glaucocarpon)* at the Arnold Arboretum, Forest Hills, Massachusetts. The insect has been reported on birch, cedar, mountain ash, mullein, and pine by other investigators. The adult is greenish in color tinged with olive and possesses a scutellum with distinct, whitish apex. When full grown the length may vary from 8 to 10 mm.

Euschistus euschistoides (Voll.). This pentatomid is recorded as a general feeder on many plants. The writer collected a number of the adults on blueberry fruit *(Vaccinium pennsylvanicum)* in Cherryfield, Maine, on August 22, 1929 and in North Sedgwick, Maine, on August 23, 1929. The adults are brown in color, often with a reddish tinge, are densely punctate, and possess membranes dotted with brown. In length they vary from 12 to 15 mm.

Chlorochroa uhleri Stal. Many adults and nymphs in the last two instars were collected sucking the juice from ripe blueberries (Fig. 18, A) on August 22, 1929. *Chlorochroa uhleri* is said to feed upon juniper, nasturtium, and willow. Its large bright green body is margined with orange thus rendering it quite conspicuous. It occurs in Alaska, in Canada and in the United States where it has been recorded from Maine to Colorado, Utah, Montana, and California.

LYGAEIDAE—The Chinch-bug Family

Nysius ericae (Schill.). Nymphs and adults of this species commonly feed on blueberry leaves in Maine. The adults are present in June and are pale gray in color and about 5 mm. (1/5 inch) in length. The insect is recorded from Canada and the entire United States.

Sphaerobius insignis (Uhl.) In June, 1928, the writer collected a few of these Lygaeids in the adult stage puncturing the

leaves of blueberry *(Vaccinium pennsylvanicum)* in Franklin, Maine. It is a relatively unimportant insect recorded from Maine, New York, Nebraska, Minnesota, Colorado, South Dakota, and Utah.

Lygaeus kalmii Stal. A number of specimens of *Lygaeus kalmii* in the adult stage were taken on blueberry foliage in August, 1927. It is a large conspicuous species with bright red markings on the elytra and commonly occurs on milkweed. Some of the females deposited eggs in the laboratory during the last week in August. It occurs in Canada and throughout the United State from Maine to Texas and California.

Ligyrocoris sylvestris Linn. Specimens of this insect were collected on blueberry leaves *(Vaccinium canadense)* in Cherryfield, Maine, on August 23, 1929. It is relatively unimportant on blueberry and occurs in Canada and the northern United States.

MIRIDAE—The Leaf Bugs

Lopidea instabilis (Reut.). Several adults of *Lopidea instabilis* were taken on blueberry leaves in North Gray, Maine, on July 24, 1929. Dr. H. H. Knight, who determined this material, says, "*L. instabilis* has been found breeding only on golden-rod." It is therefore probable that blueberry is not the preferred food plant. In addition to our Maine record of occurrence the insect has been found in Maryland and the District of Columbia.

Adelphocoris rapidus (Say). This mirid, in the adult stage, was found sucking the juice from ripe blueberries *(Vaccinium pennsylvanicum)* in North Gray, Maine, on August 2, 1929. The species occurs throughout the northern United States and commonly attacks *Rumex* (dock, sorrel).

Platytylellus rubrovittatus (Stal.). Adults of this species were taken feeding on blueberry leaves at North Gray, Maine, on July 24, 1929. It is a relatively unimportant blueberry insect. Occurrence records include Nova Scotia, Maine, New York, Massachusetts, and New Jersey.

HOMOPTERA—Leaf-hoppers, Aphids, Scale Insects, etc.

CERCOPIDAE—The Spittle Bugs

Clastoptera proteus Fitch. This insect, in the role of a blueberry pest, was first called to the writer's attention in January, 1928. At that time there were, in one of the Station greenhouses, many blueberry cuttings which had been made from plants collected in Cherryfield and Franklin the previous fall. The cuttings which had been growing nicely were suddenly attacked by spittle insects in great numbers. Since the cercopid eggs are laid in the plant stems in late summer, it is easy to understand how the plants selected might have been heavily infested with the eggs of these insects. Under greenhouse conditions the eggs had hatched in midwinter instead of in the spring.

Nature of Injury. Under greenhouse conditions the leaves and stem above the masses of froth or spittle which contained the yellowish nymphs, soon turned brown and withered. Since then the work of the insects has been observed in the field many times. Investigation has shown that, in the field, many terminals supposedly winter killed or injured by spring frosts have, in reality, been injured by the spittle insects during the preceding season. Because the eggs are in many cases deposited in the stems only two or three inches above the ground and most of the fruit is borne above this point, the plants thus attacked are so weakened that they seldom bear fruit, and if not actually killed back by the attack they are so affected that they readily succumb to winter injury.

Seasonal History. There is but one generation a season, winter being passed in the egg stage in stems of blueberry, cranberry, huckleberry and other plants. The following spring these eggs hatch and the greenish-yellow nymphs begin at once to suck the plant juices. They soon proceed to cover their bodies with a mass of white spittle or froth and this probably serves as a protection from parasites and may likewise keep their soft bodies from drying out as they naturally would if exposed continuously to the wind and sun. Sometimes one finds several nymphs or both nymphs and adults in a single mass of spittle. However, the adults move around freely, unlike the nymphs, and they soon leave the froth. Under Maine conditions the nymphs appear in

the field during the latter part of May when the plants are in blossom. By the last of July most of them have become fully developed so that the adults begin to appear in large numbers soon after. The writer observed the females engaged in laying eggs in the wood of huckleberry *(Gaylussacia baccata)* and blueberry *(Vaccinium canadense, V. corymbosum, V. pennsylvanicum)* on August 25, 1929, in southern Maine. He collected adults of this species on *V. corymbosum* in Princeton, Massachusetts, on August 7, 1929. It has been reported as a pest of blueberry by Garman (1925) in Connecticut and by Lugger (1902, p. 120) in Minnesota. Franklin (1919, p. 127) has recorded it as a pest of cranberry in Massachusetts.

Control. Under the greenhouse conditions referred to above it was easily and completely eradicated by fumigation with calcium cyanide at the rate of ¼ pound per 1000 cubic feet of space.

The practice of periodic burning in Maine blueberry fields doubtless destroys large numbers in the egg stage. Since the eggs are present in the plant stems in the spring they are destroyed with the plants at burning time every third or fourth season.

Franklin (1919, p. 127), who reports that this insect is a very important pest of cranberry, states that spraying with nicotine sulphate at the rate of 1 part in 800 parts of water to which fish oil soap (2 pounds in every 50 gallons) has been added, gives good control.

CICADELLIDAE—The Leaf-hoppers

Cicadella gothica (Sign.). This insect was collected in both nymphal and adult stages on leaves and shoots of the velvet-leaf blueberry *(Vaccinium canadense)*. The writer found both stages present on these plants in considerable abundance at Cherryfield, Maine, on August 23, 1929. The adult insect possesses reddish to grayish pronotum and elytra and varies in length from 5 to 5.6 mm. Van Duzee (1917, p. 597-598) records it on shrubs and undergrowth in pastures and swampy meadows. The writer found it on the dry, sandy "barrens". It occurs in Quebec, Ontario, Maine, New York, Pennsylvania, District of Columbia, Tennessee, and Kansas.

Oncometopia lateralis (Fab.). This large and strikingly marked insect was taken in considerable abundance by the writer

at Cherryfield, Maine, on August 23, 1929. Only adults were present at that time and they were feeding on the terminal growth of blueberry *(Vaccinium pennsylvanicum)*. The adults are 7 to 8 mm. long and have reddish elytra with black veins and linear areas. The insect is found in the United States from Maine to Florida and westward to California. It also occurs in Quebec, Ontario, and British Columbia. It is said to attack grasses and herbaceous plants.

Deltocephalus myscellus Ball. Two of the small adults were collected by the writer on blueberry *(Vaccinium pennsylvanicum)* leaves at Cherryfield, Maine, on August 23, 1929.

Gypona octolineata var. *striata* Burm. This species, in the adult stage, was likewise taken at Cherryfield, Maine, on the low-sweet blueberry *(Vaccinium pennsylvanicum)* and on the same date. The adult is greenish-yellow in color, 10 mm. (two-fifths of an inch) in length, and possesses six yellowish stripes on the vertex and pronotum. It is said to feed on various grasses, trees, and shrubs in swampy land throughout the United States and likewise in Canada.

APHIDIDAE—The Aphids or Plant Lice

Amphorophora borealis Mason. A number of specimens of this aphid were collected on the terminal growth of blueberry *(Vaccinium corymbosum)* near Brunswick, Maine, in 1927.

Macrosiphum solanifolii (Ashm.). This aphid, one of our common potato infesting species, was found attacking the terminal leaves of high bush blueberry *(Vaccinium corymbosum)* at North Sedgwick, Maine, on July 6, 1928. No other records of this aphid colonizing on blueberry have been noted.

Myzus sp. Two apparently new species of *Myzus* were taken by the writer on high bush blueberry *(Vaccinium corymbosum)* at North Sedgwick, Maine, on July 6, 1928. They were examined by Dr. Edith M. Patch, of the Department of Entomology of the Maine Agricultural Experiment Station, who stated that they represented two undescribed species in all probability. Because of the absence of adults they could not be described.

COCCIDAE—The Scale Insects

Lepidosaphes ulmi (Linn.), the Oyster-shell Scale. The well-known oyster-shell scale has been reported by Lindinger (1912, p. 333) on blueberry *(Vaccinium myrtillus)* and cranberry *(V. oxycoccus* and *V. vitis idaea)*. During the 1929 season the writer found blueberry plants of the species *Vaccinium hirsutum,* a black, pubescent berried variety, and *V. erythrocarpon* badly infested with this scale (Fig. 18, C) in the Arnold Arboretum at Forest Hills, Massachusetts. The insect occurs in Europe and North America where it attacks a variety of plants.

THYSANOPTERA—The Thrips

AEOLOTHRIPIDAE

Aeolothrips sp. A few specimens of this thrips were collected on blueberry *(Vaccinium pennsylvanicum)* near Blue Hill, Maine, in July, 1929.

THRIPIDAE

Frankliniella vaccinii Morgan[33]. This insect first came to the attention of the writer on July 15, 1926, while looking over blueberry fields in Hancock County, Maine. A peculiar "disease" was reported attacking plants in a field near Sedgwick. Upon investigation a number of patches of affected plants were found. The injury, at that time, consisted of a very tight curling of the leaves about the stems (Fig. 18, D). This was accompanied by a reddening and malformation of the leaves so affected, which was most noticeable, presumably, on those plants which had been attacked first. Examination of the tightly curled leaves revealed the presence of numerous small thrips in both the nymphal and adult stages. The injured plants were especially noticeable since they occurred, for the most part, in the "new burn" fields where the unaffected bushes were making a vigorous growth. The insects appear to attack the lower leaves first, for many plants whose lower leaves were tightly curled had their terminal leaves

[33]In manuscript.

uninjured. The following day a telephone call was received from a grower in Cumberland County, nearly 150 miles from the scene of the first outbreak. From the grower's description of his trouble it was apparent that the same insect was at work in his fields.

Importance. Since it was first observed in 1926 *Frankliniella vaccinii* has become a very noticeable and increasingly injurious pest in certain blueberry fields, especially in Hancock and Cumberland Counties. The work of this insect does not appear scattered throughout a field but is concentrated in localized areas within which practically every plant is attacked. These areas may vary in size from a few square yards up to several acres. Due to the fact that the insects remain in these spots from year to year, and that the patches increase in size each season, their attack is attracting considerable attention. The infested patches are very noticeable in the early spring since the dry, curled leaves of the previous season still remain clinging to the dead stems. Many plants which are weakened by loss of sap undoubtedly succumb to winter injury while others, not so severely attacked, do not have sufficient vigour to set fruit the following year. Because of its protection within the curled leaves during its feeding period, and within the ground during the remainder of the year, it is a difficult pest to combat.

Food Plants. Since this thrips is new to science it is especially interesting to note its feeding habits. During the 1926 season only two host plants were noted, namely the low sweet blueberry *(Vaccinium pennsylvanicum)* and whorled loosestrife *(Lysimachia quadrifolia)*. During both the 1928 and 1929 seasons the insect was found in destructive numbers in fields near Brunswick. Our observations there indicated clearly that while *F. vaccinii* feeds, under field conditions, on both the low sweet blueberry *(Vaccinium pennsylvanicum)* and the sour-top or velvet-leaf blueberry *(V. canadense)*, it much prefers the former. This preference may be due to the lack of pubescence on the leaves of *V. pennsylvanicum*. Sweet fern *(Myrica asplenifolia)* is attacked also, its leaves being discolored and curled. From an ecological viewpoint it is quite probable that this thrips has spread to the blueberry from sweet fern, whorled loosestrife, or other wild food plants which occur in the blueberry fields.

Seasonal History. The adult thrips appear in the fields in early June ordinarily, and soon lay their eggs in the leaves of the

various food plants. From two to three weeks are spent in the nymphal development which takes place within the shelter of the curled leaves. By the first week in July practically all the thrips are in the adult stage. In 10 days to two weeks the second generation of nymphs appears, many of them on previously uninfested plants with the result that a definite increase in the diameter of the affected areas may be noted. By the last of August the thrips have left the plants to winter over in the ground near the affected plants. In what stage they pass the winter is not known.

Descriptions. Specimens of nymphs and adults were submitted to Mr. A. C. Morgan for determination and he described the insect as a new species and named it *Frankliniella vaccinii.* He kindly supplied the writer with a copy of his unpublished description which is quoted as follows:

"Female: color. Thorax and antennal segments two to eight light brown, head, abdomen, legs and wings yellowish gray, first antennal segment gray—the antenna having a bicolored effect; all spines gray brown; ocelli margined with deep orange colored crescents.

"Head about 1¾ times as broad as long, broadest at the middle, the cheeks swollen behind the eyes; eyes occupy a little more than half the width of the head and fully half the length, facets of moderate size; ocelli fully normal in size, approximate and situated far back on the head, the posterior margins of the posterior pair being on a line with the hind margin of the compound eyes. Ocelli situated in a slight depression on dorsum of head; head arcuate in front between antennae; postocular spines weak; a pair of fairly strong spines within the ocellar area and contiguous to the cephalic margins of post ocellar crescents; back of head weakly transversely striate; mouth cone rather sharp pointed, reaching about ¾ across prosternum. Antennae rather stout, spines on 3rd. antennal segment alone conspicuous; 3rd. antennal segment stalked; the usual sense cones on segments 3 and 4 and a long simple cone on the inside of 6.

"Prothorax fully 1⅗ times as broad as long, sides nearly straight and parallel, posterior angles broadly rounded, spines at angles prominent, light brown, posterior and anterior marginals small; mesothorax stout. Wings reach to 9th. abdominal segment; broadest at base, at the middle about 1/11 as broad as long; costa bears 21-23 spines, anterior vein 14-15, posterior vein 10-13. Legs of moderate size, very sparsely clothed with spines.

"Abdomen normal to the genus. Spines on last two segments of medium size and long. Tenth segment weakly sulcate above for about ¾ of its length.

"Measurements of Holotype: Length 1. mm.; head, length 0.085 mm., width through the eyes, 0.134 mm., through cheeks 0.148 mm.; prothorax,

length 0.110 mm., width 0.171 mm.; mesothorax, width 0.232 mm. Dimensions of antennae in microns:—

	1	2	3	4	5	6	7	8
Length	28.5	36.7	36.7	36.7	32.6	44.6	12.2	16.3
Width	28.5	28.5	22.0	22.0	17.0	20.4	7	5

"Described from 10 females, collected from the low sweet blueberry (*Vaccinium pennsylvanicum* Lam.). Orono, Maine, C. R. Phipps, Collector.

"Male: Allotype; length 0.965 mm.; head, length 0.69 mm., width 0.138 mm.; prothorax, length 0.122 mm. Antennae very weakly infuscate beyond 1st. segment. Spines on abdomen weak except one light brown spine at caudo-lateral margin of 10th. abdominal segment. Measurements of antennal segments in microns:

1	2	3	4	5	6	7	8
20.4	32.6	34.0	36.7	32.6	44.6	10	14

"Described from one male taken in company with the holotype."

Control. Probably because of the shelter afforded by the curled leaves, spraying or dusting with nicotine sulphate, or spraying with nicotine sulphate and lubricating oil emulsion, as applied to control the pear thrips, have proven ineffective. Spring burning has no apparent control effect either, for, at that time, the thrips are safe in the ground. In fact we have seen many areas just as badly infested during the summer following burning as they were during the summer preceding.

At present the best means of control is that of burning the infested places about the middle of June when the first brood nymphs are present in abundance. A deep, slow burn at this time would be injurious to the roots. On the other hand, by previously spreading a quantity of hay over the spots to be burned, and then waiting for a windy day, a hot, rapid fire may be had. This will destroy the insects and yet leave the roots uninjured. Some growers are now using this method with success.

COLEOPTERA—The Beetles

SCARABAEIDAE—The Lamellicorn Beetles

Serica vespertina Gyll. Several of these beetles were collected feeding on blueberry leaves *(Vaccinium pennsylvanicum)*

in Brunswick, Maine, on August 12, 1927. They were determined by Mr. E. A. Chapin, Bureau of Entomology, Washington, D. C.

CHRYSOMELIDAE—The Leaf Beetles

Bassareus formosus Melsh. A few of these tiny beetles were taken on blueberry *(Vaccinium pennsylvanicum)* at North Gray, Maine, on July 24, 1929. Blatchley (1910, p. 1119) records them from Indiana on elder and wild grape. The beetles are about an eighth of an inch in length and are black in color with a number of yellow spots on the pronotum and elytra. In the laboratory they fed upon the bark and leaves of blueberry for several weeks.

Chlamys plicata Fab. This interesting little beetle is quite conspicuous since it is a case bearer. The larvae with their little dark-brown cases were taken on blueberry *(Vaccinium pennsylvanicum)* in considerable numbers in North Gray on July 25, 1928. They continued to feed until the last of August and evidently confined their attack to terminal buds on new burn fields, especially. The following season a number were collected at North Sedgwick. The beetles, which appear in late summer, are brown or bronze in color and about 4 mm. in length.

Altica torquata Lec., the Blueberry Flea-beetle. This insect is distributed throughout the blueberry districts of Maine from Cumberland County in the west to Washington County in the east. It has been by far the most abundant and injurious beetle which the writer has observed during the course of this study. It is especially destructive since it feeds upon the blueberry throughout the season, first in the larval stage and later in the adult stage. Its work is distinctive and readily recognized for while small it feeds upon the leaf margins only, making them irregular and scalloped in outline.

Seasonal History. Winter is passed in the egg stage although most other flea-beetles, under Maine conditions, hibernate as adults. From the standpoint of control this is an important difference as will be noted later. The eggs which are minute and orange-yellow in color are deposited singly on or near the ground. They hatch during the latter part of May when the buds are opening and the larvae feed first upon the buds, thus destroying and weakening many of them, and later on the leaves. The observa-

tions of the writer agree with those of Woods (1918, p. 197). Larval development requires from two to three weeks so that by the last of June practically all of the insects have pupated. Pupation takes place in the ground near the surface and ordinarily occupies from 10 to 18 days. Under field conditions, during an average season, the adult beetles emerge from the first of July on. They are coppery bronze in color and from 5.5 to 6 mm. in length. The pupae are orange-yellow in color at first and hence are quite conspicuous. Egg-laying occurs in late July.

Control. The writer first observed the work of this pest in 1925, and then only that of the adult beetles. A field near Sargentville was visited in August and at that time a patch of bushes about 20 feet square had been completely stripped. The beetles were very abundant in localized areas. They are called "snapper bugs" by some growers because of their jumping ability. The following June we received reports of injury from a number of growers in Hancock County, especially in the vicinity of Blue Hill and North Sedgwick. When the writer visited this area about the middle of June a number of fields were being stripped by the larvae. Arsenate of lead (1½ pounds in 50 gallons water) with the addition of soap (2 pounds to 50 gallons) gave very satisfactory control. A second application, early in July, may be necessary in order to control the adults.

This insect would doubtless be a much more serious and prevalent pest were it not for the practice of burning. This operation takes place in the spring before the eggs hatch and consequently they are destroyed in the burned areas. Most growers burn their fields over every third season so the insect does not have an opportunity to become excessively abundant. As in the case of many other blueberry insects, however, the "new burn" fields with their succulent growth are evidently attractive to the adult beetles and the latter migrate from less desirable locations to feed and lay their eggs in these recently burned fields. As a result the larvae are frequently destructive in fields burned over in the spring of the preceding year.

Galerucella vaccinii Fall., the Blueberry Leaf-beetle. This insect occurs throughout the State but, unlike the preceding species, it overwinters in the adult stage. Although recorded by Woods (1915, p. 286) as "the only leaf-feeding insect seriously

injurious to the blueberry which the writer has observed in Maine" it has assumed a very minor role during the past several years. In fact its presence has been hardly noticeable in commercial fields. On the other hand a large number of seriously defoliating insects, not recorded by Woods, have been noted, especially a large number of cutworms and geometers.

Seasonal History. As stated above, the beetles winter in the adult stage in protected places. They become active around the first of June and evidence of their work may be found shortly afterward. Unlike the blueberry flea-beetle which scallops the leaf-margins and later destroys the entire leaf, these beetles, and later the larvae, skeletonize the leaves. Woods (1915, p. 286) made the following statement regarding oviposition: "The first eggs were deposited on June 16, 1915, and oviposition continued about a month. One female deposits about 25 eggs, usually within three to four days after pairing." He also stated that none of the several hundred eggs deposited in the laboratory hatched. During the 1929 season the writer worked out the cycle under laboratory conditions. A female taken early in June and confined in a tin salve box deposited a number of the small, circular, yellowish eggs on June 22. These eggs all hatched on July 8, thus indicating an incubation period of about 16 days. One larva pupated on August 26 and two more on August 28. The length of larval life was, therefore, about 50 days. Adults appeared on September 6 so that the pupal period occupied about nine days. Only one generation a season occurs in Maine. The adult is yellowish at first, later changing to a reddish brown color. The light greenish-gray larvae are, like the adults, about an eighth of an inch in length when fully developed. They are thought to have three instars.

Feeding Habits and Control. The recorded food plants include willow in addition to blueberry *(Vaccinium canadense, V. pennsylvanicum,* and *V. vacillans)* as previously reported by Woods.

Spraying with arsenate of lead at standard recommendation is effective against the larvae in particular, should artificial control be necessary.

A fungus (*Sporotrichum globuliferum* Speg.) was reported by Woods as attacking this insect in the larval, pupal, and adult stages.

Cryptocephalus venustus Fab. The writer has, on several occasions, taken this prettily marked chrysomelid feeding upon the ripe blueberries *(Vaccinium pennsylvanicum* and *V. canadense)* in various parts of the State. Blatchley records it on Erigeron, ironweed, and wild sweet potato in addition to the leaves and fruit of blueberry. The adults are about ¼ of an inch in length and their elytra are marked with alternating longitudinal yellow and black stripes.

DIPTERA—The Flies

TRYPETIDAE—The Fruit Flies

Rhagoletis pomonella Walsh, the Blueberry Maggot. This is by far the most destructive insect known to attack the fruit of the blueberry under Maine conditions. It appears to differ from the well-known apple maggot only in size and habit. Since no structural differences have been detected, it is considered to be a biological strain of the apple maggot. Attempts to induce the larger apple infesting flies to oviposit in blueberry have failed thus far, and so have similar attempts to induce the smaller blueberry flies to oviposit in apple. Maggots transferred from one host to another have failed to develop to maturity.

Distribution. Throughout the Atlantic States.

Host Plants. Previous feeding records have been confined to a few closely related plants of the heath family. At this Station the insect has been bred from the three species of low-bush blueberries occurring on the barrens as well as from the huckleberry. In order of abundance these are the low sweet blueberry *(Vaccinium pennsylvanicum),* the velvet-leaf blueberry *(V. canadense),* the late low blueberry *(V. vacillans),* and the huckleberry *(Gaylussacia baccata).* It has also been reported from high-bush blueberries *(V. corymbosum)* by O'Kane in New Hampshire.

During the summer of 1925 the writer made some preliminary observations on various sorts of wild berries growing on the blueberry "barrens" of Washington County. On August 11 several of the blueberry maggot flies were noted resting and apparently ovipositing on the fruit of the Juneberry or service-berry *(Amelanchier spicata).* An examination of 500 Juneberries or

"sugar plums" as they are called locally, yielded a total of 91 maggots which were apparently identical with those found in the blueberries. Later in the season other infested Juneberries were collected in the same locality and puparia from these were placed in moist sand. Unfortunately, however, no flies emerged from this material the following season. It was not until two years later that flies were actually reared from the berries thus establishing the service-berry definitely as a host plant. It is interesting to note that the fruit of this plant ripens before that of the blueberry and therefore it probably attracts the earlier emerging flies.

The chokeberry *(Pyrus melanocarpa)* is another native plant which occurs abundantly in and around the blueberry fields. Late in the season when these hard, black fruits begin to soften, extensive examinations revealed the presence of many maggots which, as in the case of the Juneberry, appeared identical with those found in the blueberry. Many puparia were kept from these chokeberries but they subsequently failed to produce flies. From material gathered in 1928, flies were reared in 1929 thus confirming this record. These fruits which soften long after those of the blueberry are doubtless attractive to the late-emerging individuals.

Seasonal History. The life history of this insect is practically identical with that of the apple maggot. Winter is spent in the ground in puparia, often within an inch or two of the surface. In Washington County the flies begin to emerge from the soil about the middle of July when the berries are becoming blue in color. Prior to egg-laying there is a period of about 10 days during which the flies feed and mate. From the standpoint of control this is of great importance. The female flies deposit their eggs singly beneath the skin of the ripening berries and apparently lay but a single egg in a berry ordinarily, since more than one larva seldom occurs in a fruit. This is, of course, in contrast to the habit of the apple infesting flies each of which often deposits a number of eggs in a single fruit. It should be pointed out that the flies attacking the blueberry are not only markedly smaller than those of the apple but also much more active and shy. On July 23, 1926, a warm, still day, it required two hours to capture only 17 flies. On cool, windy days the flies remain hidden away amongst the lowest bushes.

It is probable that the egg hatches within two or three days after it is placed in the fruit. Some larvae are present in the fruit during the first week in August but they are very small at that time. About two weeks are spent in the larval or maggot stage during which the maggot molts twice prior to pupation. When full grown the larvae cut rough exit holes in the skin of the berries and crawl into the ground. By that time the pulp is completely broken down and, in many cases, the berries have dropped to the ground. The larvae pupate in the soil within their little barrel-shaped puparia a few days after leaving the fruit. The majority emerge as adult flies the following July although some do not emerge until the second summer or later. Thus the insect could perpetuate itself even should there occur a complete crop failure some season. Some of the stages are shown in Fig. 19, also the appearance of the larvae in the berries.

Control Measures. While the maggot has been present in the fields for many years its control did not assume particular significance until 1924. During that year several large shipments of the canned fruit were condemned because of the presence of maggots in the pack, and, as a result, the Federal authorities placed a definite tolerance or maggot limit of not over 14 in a so-called No. 2 or pint can of fruit. This at once necessitated the development of fairly accurate methods of determining the degree of infestation in sample lots. Since each canning factory obtains berries from growers scattered over a wide territory, and since the degree of infestation varies greatly between fields, it became necessary to sample or test practically every shipment. The equivalent of a pint of cooked berries is roughly a pint and a half of raw fruit and, for convenience, this quantity was selected as the standard test sample. It was found that the tedious method of opening the berries by hand and examining them one at a time was too slow and inaccurate, the smaller maggots being often overlooked in the pulp. The idea of partially cooking the berries in order to break down the pulp was then suggested. After being boiled for a few minutes the skin, seeds, and pulp are placed in a coarse sieve or strainer. By washing this material two or three times the skins are removed. Then the residue of seeds and maggots is placed in a shallow black pan containing cold water. Since both maggots and seeds are heavy and sink to the bottom, the dark,

juice-stained water can be carefully poured off a number of times in order to replace it with clear water. Then the white maggots stand out clearly against the black pan from which they can be removed by means of forceps and counted. It is important to state here that a sample taken in a field at the beginning of picking time when the maggots are small and hard to see might, as Patch and Woods (1922, p. 82) point out, show an infestation well under the legal limit whereas another sample from the same locality taken a few days later might greatly exceed the legal standard. Therefore in each of many factories, a man is employed whose duty it is to test samples of the various shipments received daily throughout the canning season.

It should be pointed out that maggot infested berries may be eaten without fear of any toxic effect, the losses occasioned by this insect being confined to its influence on the quality of the fruit itself.

Control in the Factory. During the first season of legal tolerance, canners and growers were confronted with the possibility of having thousands of bushels of berries condemned and destroyed. Therefore an effort was made to devise a factory method for the removal of the maggots from the pack. After considerable experimentation such a method was devised. A large cylinder several feet long and three to four feet in diameter is made to revolve in a shallow pan tilted enough to permit a constant stream of cold water to run through it, lengthwise. The cylinder itself is composed of galvanized iron with many small holes or perforations in it. In the center of the cylinder is placed an auger-like core to aid in stirring the berries and likewise to carry them from the hopper at one end toward the dump at the other. The infested fruit is then poured into the hopper and the motor started. As the cylinder revolves the berries are moved about and the softer ones containing the larger maggots burst open. As the process continues the berries in the lower part of the cylinder are washed in the pan of water and the liberated maggots are carried out into the shallow pan whence they are borne away in the run-off. It was found, in one factory at least, that the best results were obtained when the demaggoting cylinders were run at about eight revolutions per minute for 12 minutes with the water level just below the top of the berries. This method, while

of great value as an emergency measure to save fruit which would otherwise be condemned, by no means takes the place of field control. Among other things the process is expensive, the quality of the pack is lowered due to the loss of juice and pulp, and the loss due to shrinkage alone may be as high as 75 per cent by volume.

Control in the Field. Dusting experiments carried on during the past few seasons by Lathrop and Nickels (1930, p. 10) of the Federal blueberry maggot laboratory, indicate that two dustings with calcium arsenate will give from 82 to 89 per cent reduction in number of maggots. Their experiments included the treatment of about a thousand acres by airplane. Due to the rough nature of the country and the presence of heavy fog during the early morning hours this method is too hazardous to be feasible. In the better fields, where the yields warrant the outlay, the use of both horse-drawn and hand dusters has given economical and effective control.

Since the flies tend to breed in low, bushy, sheltered areas, such places should be cleaned up and drained if possible. The growers who are not troubled by this pest are those whose fields are kept free of competing bushes and protected breeding places.

A braconid wasp parasite, determined by Dr. R. A. Cushman as *Opius ferrugineus* Gahan, was reared from blueberry maggot pupae collected in huckleberries in Grafton, Massachusetts, on August 8, 1929. It emerged under laboratory conditions on March 7, 1930. A closely related species (*Opius melleus* Gahan) has been reared from this host in Maine.

LEPIDOPTERA—The Moths and Butterflies

GRACILARIIDAE—The Gracilariids

Gracilaria vacciniella Ely. This interesting leaf-miner was first noted on blueberry in 1929. At first the larval injury consists of a simple mine but after the first or second molt the larvae emerge from the mines and, by means of silk, draw the tip of the leaf over, forming a triangular case (Fig. 20, B). Within this shelter the cylindrical larvae feed on the surface of the leaf until fully developed. In many instances the triangular cases fall to

the ground as the larvae within become fully developed. Some of the larvae pupate within the shelter of their cases while others may spin their yellowish or white silken cocoons elsewhere. The writer first noted the cases at North Sedgwick and also at Stonington, Maine, on July 27. These were all on leaves of high bush blueberry *(Vaccinium corymbosum)* and at that time the insects were for the most part, in the larval state. Later, cases were collected in Alexander, Maine, on low sweet blueberry *(Vaccinium pennsylvanicum);* in Orono, Maine, on high bush blueberry *(V. corymbosum)* and sour-top blueberry *(V. canadense);* at East Wareham, Massachusetts, on high bush blueberry *(V. corymbosum);* and in Grafton, Massachusetts, on the late low blueberry *(V. vacillans)*. Three of the tiny moths emerged on August 27 and others on August 29, 1929.

Control. Should artificial control measures be necessary it is very likely that spraying with arsenate of lead or nicotine sulphate when the larvae are in the first or second instars would give satisfactory results.

A braconid wasp parasite, determined by Dr. C. W. Muesebeck as *Apanteles ornigis* Weed, was reared from larvae. Two specimens, one male and one female, emerged on August 2, 1929.

TORTRICIDAE—The Leaf-Rollers

Sparganothis sulfureana Clem. This insect, in the larval stage, attacks the blueberry, cranberry, grape, and strawberry. The leaves are rolled over (Fig. 20, A) and usually several are fastened together, flat, by means of silk along the edges. Within this shelter the tiny green caterpillars feed until fully developed. The grayish silken cocoons are spun up within the same shelter. From a number collected in August on various species of blueberry in Maine and Massachusetts, the first moth emerged on August 17. By that date many of the adults were out in the blueberry fields of southern Maine. During some seasons leaves thus affected are quite abundant, and it is possible that other species of leaf-rollers may be involved. The moths are about a quarter of an inch in length and are quite conspicuous because of the bright yellow color of their wings and the large, red Y-shaped mark on each fore wing.

SPHINGIDAE—The Hawk Moths

Dolba hylaeus Dru. One first instar larva was taken by the writer on blueberry in western Maine on July 18, 1928. It fed on blueberry *(Vaccinium pennsylvanicum)*, molting several times, until August 17 when it died apparently just prior to pupation.

LASIOCAMPIDAE—The Tent-Caterpillars

Malacosoma disstria Hbn., the Forest Tent-Caterpillar. A number of larvae of this common species were taken feeding on the leaves of high bush blueberry *(Vaccinium corymbosum)* in the vicinity of Sanford, Maine, on June 13, 1930. Larvae of the closely related species, the apple tent-caterpillar *(Malacosoma americana)*, were also present and feeding on the blueberry leaves.

GEOMETRIDAE—The Measuring Worms

Cingilia catenaria Dru., the Chain-dotted Measuring Worm. While the chain-dotted measuring worm or geometer has been recognized by entomologists as a resident of many years standing in this State and has periodically been reported in considerable abundance, it has never before been recorded as a blueberry pest in Maine. In fact it was not until 1924, in Canada, that the insect was revealed as an enemy of the blueberry. A number of years ago it had been mentioned as feeding on the huckleberry (1903, p. 277) in Connecticut. During the season of 1927 the larvae or loopers were present in great numbers in Maine and their feeding assumed economic importance in a number of blueberry fields, especially in Hancock County.

The insect belongs to a large family in which the adults are moths. The larvae often resemble twigs, usually have but two pairs of abdominal legs, and progress by a looping movement, bringing the posterior end forward, then advancing the anterior end, whence the common name measuring worms or loopers, and the scientific name *Geometridae*.

Economic History. This insect was named by an English worker in 1770, over a century and a half ago. It is interesting to note that the moths which he named were sent to him from New York. The species is a distinctive one both in habit and appearance. Unlike many moths the chain-dotted geometer flies by

day and, since it is above average size and possesses whitish wings, it is rather conspicuous. It was not until 1841, about 70 years after it was named, that Harris (1841) in his *Report on the Insects of Massachusetts Injurious to Vegetation* first described the looper as an injurious pest.

In 1905 an outbreak of the larvae or caterpillars was recorded in Maine by Patch (1905, p. 215) with sweet fern listed as the preferred food plant. More recently Franklin (1916) included this looper among the insect pests of the cranberry in Massachusetts. Britton (1920 and 1924) furnished further records of the insect in Connecticut. Gorham (1924) reported an outbreak of this looper in Nova Scotia destroying the cranberry and a number of other plants including the blueberry.

The foregoing constitutes a brief review of the economic history of the insect up to the present time. In summing up it may be stated that the chain-dotted geometer is a native insect; that it has been recognized as such since 1770; that its depredations have been confined to the more northern regions; and that its chief economic importance has centered around the blueberry, blackberry, and cranberry.

Food Plants. The chain-dotted measuring worm, when present in great numbers, will feed upon a fairly wide range of plants according to our Maine observations and those made elsewhere. The following list includes 45 distinct plants representing 17 botanic families. Those plants marked with an asterisk are plants upon which this looper has been observed to feed under Maine conditions.

FERN FAMILY

*Fern, *Dicksonia punctilobula* (Michx.) Gray

PINE FAMILY

*Balsam Fir, *Abies balsamea* (L.) Mill.; White Pine, *Pinus strobus* L. (Gorham, 1924); Red Spruce, *Picea rubra* (Du Roi) Dietr. (Gorham, 1924); Tamarack, *Larix laricina* (Du Roi) Koch. (Mosher, 1917, p. 43-44).

SEDGE FAMILY

*Sedge, *Carex pennsylvanica* Lam.

WILLOW FAMILY

*Poplar, *Populus* sp.; *Willow, *Salix candida* Flugge

SWEET GALE FAMILY

*Bayberry, *Myrica caroliniensis* Mill.; *Sweet Fern, *Myrica asplenifolia* L.

BIRCH FAMILY

*Alder, *Alnus* sp.; *Gray Birch, *Betula populifolia* Marsh.; *White Birch, *Betula alba* var. *papyrifera* (Marsh.) Spach.; Hazelnut, *Corylus* sp. (Britton, 1904, p. 277).

BEECH FAMILY

Beech, *Fagus* sp. (Gorham, 1924); Chestnut, *Castanea* sp. (Britton, 1904, p. 277); Oak, *Quercus* sp. (Britton, 1904, p. 277).

NETTLE FAMILY

Elm, *Ulmus* sp. (Gorham, 1924).

PLANE TREE FAMILY

Sycamore, *Platanus occidentalis* L. (Gorham, 1924).

ROSE FAMILY

Apple, *Pyrus malus* (Hill) S. F. Gray (Britton, 1904, p. 277); Blackberry, *Rubus sp.* (Lugger, 1898, p. 240-241); Wild Cherry, *Prunus* sp. (Sanderson, 1906, p. 74); *Hardhack, *Spiraea tomentosa* L.; Hawthorn, *Crataegus* sp. (Gorham, 1924); *Meadowsweet, *Spiraea latifolia* Borkh.; Pear, *Pyrus communis* L. (Gorham, 1924); Plum, *Prunus* sp. (Gorham, 1924); *Raspberry, *Rubus strigosus* Michx.; *Rose, *Rosa* sp.

PULSE FAMILY

Wild Indigo, *Baptisia tinctoria* (L.) R. Br. (Webster, 1892, p. 179); Woodwax, *Genista tinctoria* L. (Webster, 1892, p. 179).

CASHEW FAMILY

Sumach, *Rhus* sp. (Britton, 1904, p. 277).

MAPLE FAMILY

Sugar Maple, *Acer saccharum* Marsh. (Gorham, 1924); White Maple, *Acer saccharinum* L. (Gorham, 1924).

SOAPBERRY FAMILY

Horse chestnut, *Aesculus* sp. (Gorham, 1924).

HEATH FAMILY

Cranberry, *Vaccinium* sp. (Franklin, 1916); *Low Sweet Blueberry, *Vaccinium pennsylvanicum* Lam.; *Sour-top Blueberry, *Vaccinium canadense* Kalm.; *Huckleberry, *Gaylussacia baccata* (Wang.) C. Koch; Rhododendron, *Rhododendron* sp. (Gorham, 1924).

OLIVE FAMILY

Ash, *Fraxinus* sp. (Gorham, 1924).

COMPOSITE FAMILY

*Everlasting, *Anaphalis margaritacea* var. *occidentalis;* Golden-rod, *Solidago* sp.; *Wild Lettuce, *Lactuca canadensis* L.; *Rattlesnake-root, *Prenanthes alba* L.

The two botanic families which include the greatest number of recorded food plants are the Rose Family with 10 species, and the Heath Family with five species. The former includes the blackberry and the latter the blueberry, huckleberry, and cranberry which comprise the principal economic host plants of this insect.

Habits and Nature of Injury. Outbreaks of the larvae sometimes occur on high land but nearly all of our records indicate that, in the beginning at least, the infestations were confined to bog or low land. The outbreaks observed by the writer during the 1927 season had their inception in low land. Later on, due to scarcity of food, the loopers migrated in army worm fashion to higher land. In one instance they gradually ate their way out of a swamp, then across a field containing a considerable stand of sweet fern and other bushes, and finally migrated into a large blueberry field. The worms were so numerous that in many cases there were three or four loopers to a single plant. At that time the blueberry crop was being harvested and the worms not only defoliated the bushes but also ate the berries, ripe and otherwise. Areas over which the loopers had fed were brown and, from a distance, appeared as though they had been swept by fire. The majority of the caterpillars were then in their last instar and capable of consuming a considerable quantity of foliage in a

short period of time. When disturbed these inchworms or spanworms will, in common with other loopers, hold their bodies stretched out rigidly at an angle with the stem thus simulating a branch or twig.

In the 1928 and 1929 seasons widespread outbreaks occurred in western Maine. The areas attacked were large and nearly every tree and plant within them was defoliated.

When through feeding and ready to pupate, each looper begins to construct its cocoon. It proceeds to weave and spin a loose netting or cocoon which it attaches to the leaves or stem of the plant on which or near which it had previously been feeding. Many cocoons were noted on the trunks and branches of balsam fir and other conifers in the fields as well as on the blueberry and other low-growing bushes.

Seasonal History. This measuring worm is single brooded with the adult or moth stage occurring in the fall. In the Eastern States emergence usually begins about the middle of September and continues until the middle or last of October. The first moth seen in the field in 1927 was noted emerging from its chrysalis on September 13. On that date one moth emerged in the laboratory and during the following two weeks the majority of the moths made their appearance. Mating takes place within a few days after emergence and egg-laying begins a day or two later. The writer observed the process of egg-laying in the fields and in the laboratory on a number of occasions during the 1927 season. On September 23 a number of females were found ovipositing in blueberry fields near Brunswick. The moths flew lazily about depositing their eggs. The usual procedure was first to alight upon the upper surface of a sweet fern leaf. The abdominal segments were then bent down and under the leaf or twig and the ovipositor extended until an egg was attached to the lower surface. The eggs were laid singly, the female moths often flying to another bush after depositing one egg. In many cases the tiny green eggs subsequently failed to stick and dropped to the ground. Sanderson made a similar observation in New Hampshire. Our observations indicate that the moths select the sweet fern in preference to other plants for the purpose of egg deposition. However, it is likely that a number of other plants may be utilized for this purpose inasmuch as some of the moths were found ovipositing on a species of brome grass (*Bromus ciliatus* L.) which occurs abund-

antly in certain of the blueberry fields. The writer captured a number of females and they continued egg-laying in captivity, in some cases for two weeks or longer. The moths confined in glass vials laid their eggs on pieces of cheese cloth and on the sides of the vials, or in some cases simply dropped them at random. The greatest number of eggs laid by any individual was 257 but this number probably did not represent the maximum as she presumably had deposited some eggs before being captured. Lugger (1898, p. 241) recorded the maximum number in his experimental work as 368. Gorham (1924) reported an average of 140 per female.

A few days after oviposition the eggs change in color from light green to lilac and later to brown. Winter is passed in this stage. The sweet fern leaves being deciduous the majority of the eggs lie on the ground under a blanket of snow during the winter months. We have no record covering the usual time of hatching but as the mature larvae were not present until the latter part of August during the 1927 season hatching probably had not taken place until about the first of June. According to Dyar (1901, p. 250-251) the caterpillars pass through five larval instars or growth stages before attaining their growth. At the end of each instar the looper discards the old skin which it has outgrown and acquires a new and larger one.

Upon attaining maturity each worm spins a loose net about itself and then proceeds to cast off its last larval skin. From three to four weeks are spent quietly in this net which resembles a hammock or swing. Then the pupal skin breaks open in the region of the head and the moth crawls forth to remain quietly attached to the supporting twig or cocoon until its wings are dried out. A few pupae were noted in the fields on August 18 and the first moth was observed, as stated above, on September 13.

Descriptions. The chain-dotted geometer in common with other moths passes through four stages in completing its life cycle. These stages are (1) the adult or moth stage, a period of dispersal and egg laying; (2) the egg stage in which winter is passed; (3) the larval, caterpillar, or looper stage during which the destructive feeding occurs; (4) the pupal or resting stage during which the insect remains quietly suspended in its cocoon.

Adult. Wings smoky white, thin and rather transparent. Outer edge of both fore and hind wings marked by a faint black line interrupted by a number of distinct black spots. Wing expanse from one and one-tenth to one and eight-tenths inches. (Fig. 21, A & B).

Egg. Pale yellowish green in color at first, later turning dark violet and becoming even darker before hatching; elliptical in shape and less than one-twelfth of an inch in length.

Larva. Body yellowish, slender with conspicuous black spots on the sides. Length when full grown from one and one-half to nearly two inches. (Fig. 21, C & D).

Pupa. White in color marked with conspicuous black blotches. Length about three-fourths of an inch; greatest width about one-sixth of an inch. (Fig. 21, E & F).

Each larva or looper constructs a cocoon before changing to the pupal condition. This cocoon consists of a loose net work of coarse, yellow threads with such large meshes that the pupa within is readily discernible (Fig. 21, G). After completing the cocoon the larva casts its last larval skin out through one of the meshes and quietly awaits its emergence date.

Control. Little or nothing appears to have been published on the subject of the economic control of this pest. In cranberry bogs outbreaks of this and similar loopers are often controlled by flooding the bog for a short time, thus drowning the pests. This procedure would, of course, be impossible in blueberry fields because of the topography.

Loopers or geometers, unlike cutworms, are readly poisoned by arsenicals used as a spray at the strength normally recommended for the control of orchard insects. The writer was afforded an excellent opportunity to test the efficiency of arsenate of lead during the 1927 season. In one locality it so happened that when the outbreak was first noted the loopers had just finished stripping nearly every green plant in a low lying pasture adjacent to a large blueberry field. When this outbreak was discovered the worms were crossing over into the berry field in vast numbers. At no point had they penetrated more than a few feet into the field although they were entering it along one entire side, a distance of several hundred yards. A small compressed air sprayer was employed to apply the mixture to a narrow strip along the edge of the field and just in front of the line of march. Arsenate of lead was used at the rate of one and one-half pounds (dry) in 50 gallons of water. The following morning an examination of

the field was made. While only a few of the loopers were actually dead, the great majority appeared decidedly "sick" as evidenced by a failure to eat or to move about actively. None of the worms had progressed beyond the sprayed strip and as a matter of fact very few ever did. Twenty-four hours later (48 hours after spraying) practically all of the loopers in that area were dead or inactive. Therefore the control was both effective and inexpensive. Of course conditions are not always ideal, nor, on the other hand, are all growers as observant as this one. In some instances an attack may be more or less scattered over a blueberry field thus necessitating the expenditure of more time and spray material. Before attempting to determine the effectiveness of the treatment the grower should wait at least 48 hours after the poison has been applied.

Natural Enemies. During the 1927 season the writer noted that under Maine conditions a very small per cent of the worms died from the effects of disease. Gorham (1924) in Nova Scotia reared three tachinid fly parasites (*Madremyia saundersii* Willst., *Masicera festineus* Meig., and *Zenillia vulgaris* Fallen) from the larvae.

Our 1927 breeding experiments resulted in our obtaining data on three different species of parasites. One of these (*Madremyia saundersii*) had previously been recorded by Gorham as stated above. The second species (*Itoplectis conquisitor* (Say)), a hymenopterous parasite, had likewise been reared from this insect. The third species (*Meteorus datanae* Mues.) was by far the most abundant. Larvae parasitized by this insect usually remain clinging to the bushes on which they die. The parasites then emerge from the dead or dying caterpillars and proceed to spin a thread three or four inches in length. One end of the thread is attached to a twig or leaf and the parasite hangs from the other end. In a short time the insect which is in the larval stage transforms to the pupal stage and remains suspended in close proximity to the body of its victim. Therefore these parasite cocoons can be readily seen and collected. The first of these cocoons was found in North Sedgwick on August 18. The majority of the adult wasps emerged from these cocoons during the week of August 29 thus indicating that the pupal period lasts from a week to ten days. From five to ten per cent of the loopers were parasitized by this species alone. Two secondary parasites (*Hemiteles*

tenellus (Say) and *Mesochorus luteipes* Cress.) were reared from the cocoons of *Meteorus datanae* Mues.

During the course of another widespread outbreak in Cumberland County in July, 1929, the writer obtained larvae from which he reared two fly parasites (*Winthemia quadripustulata* Fab. and *Madremyia saundersii* Willst.) both of which were determined by Dr. J. M. Aldrich. In addition we found a chalcid wasp very active in parasitizing the nearly full grown larvae of *Cingilia catenaria*. These interesting wasps with their greatly thickened hind femora usually alight just back of the head of the victim. From this vantage point they cannot readily be dislodged despite the frantic squirming of the caterpillars. The individuals observed by the writer remained on the bodies of their victims as long as half an hour in some cases and, during the course of this period, punctured the bodies of the larvae many times with their ovipositors. The species in question was placed by Mr. A. B. Gahan as *Brachymeria* n. sp.

Amphidasis cognataria Gn. A single larva was taken on blueberry *(Vaccinium pennsylvanicum)* at North Sedgwick on August 21, 1929. It was subsequently fed upon blueberry in the laboratory until it pupated on September 20, 1929. The adult emerged on March 22, 1930. The moth has a wing expanse of about one and one-fourth inches and is gray with dark markings. It occurs in the Atlantic States and in Canada.

Glena cognataria Hbn. The writer has taken this reddish-brown geometer in some numbers in blueberry fields in North Gray during the 1928 and 1929 seasons in company with larvae of another moth. Material collected on July 13, 1928, subsequently lived on blueberry *(Vaccinium canadense* and *V. pennsylvanicum)* until August 17 when most of them pupated. One larva pupated on August 25. Due to parasitism or disease no moths emerged from these pupae.

During 1929 more larvae were collected in the same locality. They were likewise reared on blueberry and pupation occurred from July 27 to August 17. A few adults which would ordinarily appear in the spring under field conditions, emerged in the laboratory on December 14, 1929. The moths are slate gray in color and have a wing expanse of about three-fourths of an inch. They are said to occur in the Atlantic States.

Mesothea incertata Wlk. A single larva was collected on high bush blueberry *(Vaccinium corymbosum)* in Orono, Maine, in August, 1929. It pupated on August 28 and the moth emerged in the laboratory on December 20, 1929. The moth is a very pretty one with pale green wings and has a wing expanse of about half an inch. The species is found throughout the Atlantic States.

Euchlaena serrata Dru. While collecting cutworms at North Sedgwick on the night of May 16, 1929, the writer found a large, light gray, geometrid larva about two inches in length feeding on the leaves of blueberry *(Vaccinium pennsylvanicum)*. It pupated on June 5 after feeding on blueberry, spiraea, and ground ivy in the laboratory. The pupal period occupied about two weeks and the moth appeared on June 20, 1929. It is a large, beautifully marked moth with a wing expanse of about one and one-half inches. The body and wings are light yellow in color and both fore and hind wings have a broad, dark-brown band along the outer margin.

noctuidae—Cutworms and Owlet-Moths

These insects belong to a very large family in which most of the larvae and adults are active at night. Because of their nocturnal habits and the shiny owl-like eyes of the moths they are called *Noctuidae* (from the Latin *Noctua* for owl). The majority of the larvae are stout, hairless, dull grayish or brownish cutworms possessing five pairs of prolegs. Many species sever the stems of plants near the ground (whence the name cutworms), while others have the habit of climbing the plants to feed on foliage or flowers.

Under Maine conditions the blueberry is subject to attack by a number of cutworms. While such well known and destructive species as the spotted, dingy, W-marked, and black army cutworms are included in the list many of the most destructive forms have no previous economic record. Since the widespread outbreak of the black army cutworm in 1925, night collections have revealed the surprising fact that over 25 species of cutworms feed upon the blueberry in Maine. It is interesting to note that the destructive spring outbreaks always occur on "new burn" fields, presumably because of the succulent plant growth on them.

On the other hand, the summer feeding noctuids such as *Drasteria graphica atlantica* and *Polia subjuncta,* which are not typical cutworms in appearance and habits, may not be so selective. The habits of the various bud-eating species are practically identical. During the latter part of April and early May the partly grown cutworms come out of their hibernating quarters at night and climb up on the plants in order to reach the swelling fruit and leaf buds. (Fig. 22, A & B).

Since control measures are similar for most species of cutworms they are discussed at length here in order to avoid repetition in connection with each species.

Natural control. There are several natural factors which influence the abundance of cutworms. Our native birds are of great value in this connection for they consume quantities of caterpillars, the crow, gull, blue jay, robin, bluebird, and many others being especially active and beneficial.

Climatic conditions play an important role in the abundance of cutworms and other insects. Sudden changes from very cold to rather warm weather during the winter tend to destroy all species of cutworms. Heavy rains during the fall often result in the reduction of their numbers by drowning. Early springs often make their presence more pronounced (especially climbing forms) probably because the worms emerge from the ground during such seasons before there is very much vegetation and, consequently, they are forced to feed upon swelling buds.

Fungous diseases which may destroy countless numbers almost overnight develop under certain combinations of moisture, temperature, and humidity. The weather also regulates, to some extent, the abundance and activity of parasites.

Artificial control. In gardens or small fields hand gathering may sometimes be practicable. The cutworms may be located during the daytime in the soil at the base of the plant attacked. It is much easier, however, to find them on the plants at night by means of a lantern or flash light. At that time they may be collected and destroyed without much effort.

Although spraying or dusting with arsenicals doubtless has some value it is not a practical method of control, especially in large blueberry fields. The foliage grows so rapidly in such areas that fresh, unpoisoned growth is constantly available. Fur-

thermore, the caterpillars are quite resistant to normal dosages of arsenicals.

The most effective control either in small gardens or large fields may be obtained by the use of poisoned baits, including poisoned bran mash. Among the many formulas for the preparation of the latter, the following one has proven satisfactory in the control of many cutworms:

Bran	20 pounds
Paris green or finely powdered white arsenic	1 pound
Molasses	2 quarts
Water (enough to moisten) about	3 gallons

In preparing the bait first mix the dry ingredients, bran and Paris green or white arsenic, together thoroughly. Then mix the molasses and part of the water until all the molasses is dissolved. The two mixtures should then be combined and more water added, a little at a time, until the whole mass is evenly moistened. It is important that the bran should not be wet or sloppy but that it should crumble readily. If permitted to stand a few hours before using, the poison will be more evenly distributed throughout the bran. Lead arsenate or calcium arsenate are not effective as substitutes for Paris green, and white arsenic, unless it be finely powdered, is of little value.

Since the worms work at night and since the mash is not effective if dried out it should not be applied until sundown or later.

Cook (1920, p. 8) states that bait without molasses is worthless as far as the black army cutworm is concerned and he recommends using an excess of it. This is in contrast to the experience of certain other workers who find that for some cutworms an attrahent (attracting material) such as molasses is unnecessary.

In gardens the bait should be broadcasted along the rows by hand. If it is thinly and evenly scattered there is little danger of poisoning poultry or livestock. In large areas such as blueberry fields vast quantities might be required if the whole section had to be broadcasted. Early in the season, however, certain cutworms at least are concentrated in localized areas such as ridges or knolls. Consequently control may often be obtained at

that time by treating limited areas. Since the moths are evidently attracted to the higher land for the purpose of egg-laying, such portions of new burned fields should be watched carefully in the spring and treated if necessary.

Euxoa redimicula Morr., the Fillet Dart Moth. On the night of May 16, 1926, the writer took two larvae of this species feeding on blueberry buds at Bonny Eagle, Maine—near Sebago Lake. One larva subsequently pupated and gave rise to a moth on July 26, 1926. The larvae are dark reddish-brown in color and about one and one-fourth inches in length when full grown. The moth is dark fuscous brown with a dark triangle in the cell before the orbicular spot and with a black area between the orbicular and reniform spots. The reniform spot is very dark and so are the hind wings. This insect has been recorded from Canada and in the United States from Maine to New Jersey and Colorado.

Feltia ducens Wlk., the Dingy Cutworm. This is a northern species which is found in Canada and in the United States. It has been recorded from Maine and New York south to Virginia and Tennessee and westward in Missouri, Colorado, and Utah.

Food Plants. According to Crumb (1929, p. 59) the food plants of *Feltia ducens* include *Aster ericoides*, bean, bluegrass, cabbage, celery, chickweed, clover, corn, goldenrod, lettuce, melon, mullein, pea, plantain, potato, *Rumex crispus*, rye, strawberry, sweet potato, tobacco, turnip, wheat, and the buds of fruit trees. In Maine it also attacks blueberry buds *(Vaccinium pennsylvanicum* and *V. canadense)*.

Seasonal History. The writer collected a number of larvae on the nights of May 11 and 12, 1928, in blueberry fields near Brunswick, Maine. They were feeding on swelling blueberry buds in company with a number of other species of cutworms and were about half grown, thus indicating that they spend the winter in the larval stage. After becoming full fed the larvae remained in a somewhat dormant condition from the last of June until the first of August before pupating. In this respect they differ from any of the other species which the writer has reared. The moths emerged during the second week in September. Crumb (1929, p. 60) refers to the inactive larval period as follows: "In this species the larvae pass a long, inactive period in the soil during

the summer. Before the larva enters this state an irregularly roughly plastered cell is made, usually within one-fourth inch of the surface of the soil, into which the larva retires....After about three months spent thus in the soil, the larvae are nearly as plump as in the beginning." Thus far this cutworm has not appeared in significant numbers in the blueberry fields.

Description of Stages

Adult. Ground color of forewings gray, orbicular spot V-shaped and confluent with pale sub-marginal coloration of the costa; wing expanse about 1½ inches.

Egg. Described by Crumb as whitish, oblong-oval in outline, 0.66 mm. long, 0.5 mm. wide, and 0.38 mm. high.

Larva. Color grayish-brown to brown without distinctive markings, length of full grown larva from 1 to 1¼ inches.

Pupa. Length 17 to 18 mm., width about 6 mm. Cremaster with a pair of long, stout, convergent terminal spines, nearly approximate at base.

Parasites and Predators

The following parasites are listed by Crumb (1929, p. 66-68): *Micropolitis feltiae* Mues., *Berecyntus* sp., *Gonia frontosa* Say, *Paranomalon propinquum* Cress., *Apantcles griffinii* Vier., *Ophion bilineatum* Say, *Meteorus vulgaris* Cress., *Meteorus autographae* Mues., *Rogas aciculatus* Cress., *Anthrax hypomelas* Macq., *Phorocera claripennis* Macq., *Winthemia quadripustulata* Fab., *Meteorus dimidiatus* Cress.

The beetles, *Scarites subterraneous* Fab. and *S. substrictus* Hald., and a spider, *Xysticus nervosus* Banks, are said to be predators.

Agrotis bicarnea Gn., the Pink-spotted Dart Moth. This relatively unimportant species has been recorded from Canada, and the United States where it is found in the Atlantic States and westward in Illinois and Colorado.

Food Plants. Our Maine records include blueberry *(Vaccinium pennsylvanicum)*, gray birch *(Betula populifolia)*, dandelion (*Taraxacum officinale* Weber), maple (*Acer* sp.), and meadow-sweet (*Spiraea latifolia* Borkh.).

Seasonal History and Importance. While it appears to be distributed widely in the State it has not been found in abundance in blueberry fields. Several partly grown larvae were taken near Bath, Maine, on the night of May 10, 1929. They were feeding on swelling blueberry buds. Others were collected later in North Sedgwick on the night of May 16. One larva pupated on May

24 and the moth emerged on June 28. A second larva pupated on May 27 and gave rise to a moth on July 1. A third larva pupated on May 29. The average length of time spent in the pupal stage was 35 days. As in the case of the preceding species, winter is passed in the larval stage.

Description of Stages

Adult. Fore wings blackish brown with orbicular and reniform spots lighter, lighter ochreous area before the anterior transverse line. Wing expanse 1¼ inches. (Fig. 15, D).

Larva. Light brown with lighter dorsal and sub-dorsal lines, the former bordered with dark brown. Length when full grown about 1¼ inches. (Fig. 23, A).

Pupa. Length about 16 mm., width 5 to 6 mm. Cremaster with a pair of strongly curved, terminal, forceps-like spines which meet to form a circle.

Agrotis c-nigrum Linn., the Spotted Cutworm. This species occurs in Canada, Alaska, northern United States, Europe, Asia, India, and Java. It is as destructive as it is widespread.

Food Plants. The spotted cutworm has long been recorded as a general feeder on apple, beet, cabbage, Canada thistle, carrot, cauliflower, celery, chickory, chickweed, chokecherry, clover, corn, currant, ferns, gooseberry, grasses, Helianthus, Lobelia, maple, mangel, oat, pea, pear, rhubarb, Solidago, tobacco, tomato, violet, and wheat. In addition the writer has found that, in Maine, it feeds upon meadow-sweet (*Spiraea latifolia* Borkh.), sweet fern (*Myrica asplenifolia* L.), Viburnum (*Viburnum* sp.), and two species of blueberry (*Vaccinium canadense* and *V. pennsylvanicum*).

Seasonal History and Importance. The spotted cutworm is one of the most wide-spread and destructive cutworms known. It is a true climbing species feeding on swelling buds on trees and shrubs in the spring. When present in abundance it assumes the army worm habit, defoliating large areas. During the past two seasons it has been quite destructive in certain Maine blueberry fields. On the nights of May 11 and 12, 1928, a number of these cutworms were taken on the blueberry plains near Brunswick. At that time they were, for the most part, in the last larval instar thus indicating that, under Maine conditions, they overwinter as nearly full grown larvae.

TABLE 1

Pupal and Emergence Records

Pupated	Emerged	Duration of Pupal Stage
May 26, 1928	June 13, 1928	18 days
May 26, 1928	June 13, 1928	18 days
May 22, 1928	June 10, 1928	19 days
May 31, 1928	June 25, 1928	25 days
May 26, 1928	June 13, 1928	18 days
May 26, 1928	June 15, 1928	20 days
May 20, 1929	June 6, 1929	17 days
May 22, 1929	June 7, 1929	16 days
May 27, 1929	June 7, 1929	11 days
May 22, 1929	June 10, 1929	19 days
May 19, 1930	June 5, 1930	17 days
May 31, 1930	June 24, 1930	24 days
June 2, 1930	June 16, 1930	14 days
June 2, 1930	June 23, 1930	21 days
June 3, 1930	June 26, 1930	23 days
June 4, 1930	June 19, 1930	15 days

The shortest length of time spent in the pupal stage was 11 days and the longest 25 days, with an average of slightly over 18 days. Eggs were obtained on July 25, 1930, from moths taken in a light trap. Many of these eggs hatched on July 31, 1930. Partly grown larvae sent in to the laboratory feeding on dry beans the last of July indicated the presence of a second generation and this is borne out by Gibson's (1915, p. 23-24) observations in Canada.

Description of Stages

Adult. Fore wings fuscous tinged with brown, with dark, transverse dash on costa. Orbicular spot V-shaped and open anteriorly, light brown in color and bordered posteriorly and laterally with a broad, black area. Hind wings pale with a brownish tinge. Wing expanse about 1½ inches. (Fig. 15, E).

Egg. White, circular, 0.60 to 0.65 mm. broad and 0.50 to 0.60 mm. high.

Larva. Yellowish gray in color with a series of sub-dorsal, segmental, black, triangular spots, larger and more pronounced posteriorly. Length when full grown 1¼ to 1½ inches. (Fig. 23, B.)

Pupa. Length about 18 mm., width 5 to 6 mm. Cremaster with 1 pair large, parallel, terminal spines hooked at ends, and 1 pair small, light colored, lateral spines.

Parasites

The following parasites have been reared from this cutworm: *Ophion bilineatum* Say, *Amblyteles comes* (Cress.), *Apanteles xylinus* (Say), A.

yakutatensis Ashm., *Winthemia quadripustulata* Fab., *Phorocera claripennis* Macq., *Amblytcles seminiger* Cress., and *Euplectrus bicoltor* Swed.

Agrotis fennica Tausch., the Black Army Cutworm. The black army cutworm has been known for many years in the United States and Canada although it was not until 1925 that it was recorded as a blueberry pest. This species also occurs in Europe where it is confined to the more northerly regions. One of the earliest outbreaks in this country occurred in Michigan in 1884. Lugger (1896) reported a similar widespread outbreak of this species in Minnesota.

More recently Britton (1926, p. 324) reported the destructive attack of this insect on apple trees in a nursery in Durham, Connecticut. Pettit (1926, p. 221) records an unusually severe outbreak in Michigan where it fed upon a wide variety of plants.

Importance in Maine. As early as 1884 Maine suffered a serious outbreak of the black army worm. According to Cook (1884 b) "a rare insect, the black army worm, has appeared in the state." The attack was first noticed in the vicinity of Waterville in the early summer of 1884. Strawberry plants, in particular, were destroyed as well as peas, asparagus, and many other crops.

During 1924 this cutworm was present in Maine and did conspicuous damage. In May, 1925, Maine experienced another and even more serious attack. As stated above, the insect has a wide range of food plants but it so happens that the blueberry, prior to 1925, had never been noted as one of them. The damage done by the black army cutworm in 1925 was tremendous. Many blueberry fields in different parts of the State were stripped, first of buds and later of blossoms and leaves. A survey of the situation by the Experiment Station during the summer revealed the fact that the damage was distributed throughout the entire blueberry producing section of the State. This territory extends from Portland to Calais and includes part of York, Cumberland, Penobscot, Washington, and Hancock Counties. Throughout this area blueberry growers suffered individual losses varying from $500 to $2500, and one grower reported a loss of over $8000. It is safe to say that the loss in Hancock County alone was in the neighborhood of $100,000. Other crops were attacked also, especially garden plants and nursery trees. One thousand seedling

apple trees in a nursery near Monmouth were reported to be seriously injured.

It is entirely reasonable to suppose that this insect is not as new in its role as a blueberry pest as has been assumed by some. Reports of peculiar "frosts" which often struck only the ridges or which were singularly localized, as well as accounts of crop failure from unknown causes, make it appear likely that this species has been active in blueberry fields for a number of years. Since these cutworms are active chiefly at night and are ordinarily hidden away by day it is not so strange that they have escaped the attention of the growers, possibly for a long time.

Food Plants. The black army cutworm feeds upon a variety of unrelated plants including members of 20 plant families. In the following list those species preceded by an asterisk indicate Maine records.

FERN FAMILY

*Fern, *Dicksonia punctilobula* (Michx.) Gray.

LILY FAMILY

*Asparagus, *Asparagus officinalis* L.; Onion, *Allium* sp. (Cook, 1884a).

WILLOW FAMILY

Poplar, *Populus* sp. (Lugger, 1896, p. 48); Willow, *Salix* sp. (Lugger, 1896, p. 48).

SWEET GALE FAMILY

*Sweet Fern, *Myrica asplenifolia* L.

WALNUT FAMILY

Black Walnut, *Juglans nigra* L. (Gibson, 1912, p. 29).

BIRCH FAMILY

*Alder, *Alnus* sp.; *Birch, *Betula* sp.

BEECH FAMILY

*Beech, *Fagus* sp.; Oak, *Quercus* sp. (Gibson, 1912, p. 29).

NETTLE FAMILY

Elm, *Ulmus* sp. (Gibson, 1912, p. 29).

BUCKWHEAT FAMILY

Dock, *Rumex* sp. (Cook, 1884a); *Yellow Sorrel, *Rumex crispus* L.

GOOSEFOOT FAMILY

*Pigweed, *Chenopodium album* L.

MUSTARD FAMILY

Pepper Grass, *Lepidium virginicum* L. (Fletcher, 1890, p. 248).

SAXIFRAGE FAMILY

*Flowering Currant, *Ribes* sp.

ROSE FAMILY

*Apple, *Pyrus malus* (Hill) S. F. Gray; Wild Cherry, *Prunus* sp. (Lugger, 1896); *Chokeberry, *Pyrus melanocarpa* (Michx.) Willd.; *Meadow-sweet, *Spiraea latifolia* Borkh.; *Wild Raspberry, *Rubus strigosus* Michx.; *Wild Rose, *Rosa* sp.; *Strawberry, *Fragaria chiloensis* Duchesne.

PULSE FAMILY

*Red Clover, *Trifolium pratense* L.; *White Clover, *Melilotus alba* L.; *Common Pea, *Pisum sativum* L.; *Cow Vetch, *Vicia cracca* L.

CASHEW FAMILY

Sumach, *Rhus* sp. (Lugger, 1896).

MAPLE FAMILY

Box Elder, *Acer negundo* L. (Gibson, 1912, p. 29); Maple, *Acer* sp. (Gibson, 1912, p. 29).

DOGWOOD FAMILY

*Bunchberry, *Cornus canadensis* L.

HEATH FAMILY

*Low Sweet Blueberry, *Vaccinium pennsylvanicum* Lam.; *Sour-top Blueberry, *Vaccinium canadense* Kalm.; *Laurel or "Lambkill", *Kalmia angustifolia* L.

FIGWORT FAMILY

Wood Betony, *Pedicularis canadensis* L.; *Sow Thistle, *Sonchus oleraceous* L.

COMPOSITE FAMILY

*Aster, *Aster* sp.; *Golden-rod, *Solidago* sp.; *Sow Thistle, *Sonchus oleraceous* L.

Seasonal History. The small overwintering caterpillars appear during the first warm nights early in the spring. At that time many of them are about half an inch in length. In Maine the time of appearance varies slightly from late April to early May in the southern part of the State. In the northern counties appearance is usually delayed from three weeks to a month. After feeding for five to six weeks the larvae become full grown and enter the ground. There they pupate and remain until they emerge as moths about three weeks later.

The first pupae reared from cutworms collected in Cumberland County in May, 1926, were obtained on June 1, while the first pupa from the Hancock County collection (taken June 7) did not put in its appearance until June 21. The greatest length of time spent in the pupal stage was 24 days and the shortest period recorded was 16 days. The average length of time was 21⅓ days.

The first adults or moths reared from the Cumberland County material emerged on June 16 and June 18, while those from the Hancock County collection did not emerge until July 13 and July 15, practically a month later. According to Canadian writers (Gibson, 1915, p. 28) the moths are on the wing there from the middle of June to about the middle of September. The moths themselves do no harm except indirectly in laying the eggs from which the young cutworms hatch. In common with other cutworm moths the black army cutworm moth flies at night and feeds on nectar taken from various flowers. Norman (1876, p. 67) observed the moths visiting Spiraea blossoms. This is the only feeding record of the adult which the writer has found.

As indicated earlier in the discussion of factors influencing insect abundance in the fields, the new burn fields are subject to the more serious cutworm attacks. Moreover, the ridges or higher sections are usually attacked first thus indicating that the moths select such areas for egg-laying purposes. Because of the larger yields on new burn fields it is important that growers should be familiar with the habits of the various cutworms in order that they may watch such fields closely.

The small cutworms at first do not destroy the entire bud but eat out a part, leaving the bud scales behind. Later the bud scales turn brown thus giving the plants the appearance of having been injured by early frosts. In fact until recently it was thought that frosts were the cause of all the injury which we now attribute to the agency of cutworms.

Since the caterpillars work at night and remain hidden away by day the best time to look for them in the fields is at night. They are then quite conspicuous because of their habit of climbing directly to the top of the plant in order to feed on the terminal buds first. For that reason by means of a flash light or lantern they may be readily observed.

Description of Stages

Adult. Fore wings shiny blackish brown, orbicular spot with dark center outlined in light yellow; reniform spot dark and more or less heavily outlined in reddish brown. Hind wings gray shading to brown at the margins. (Fig. 15, F).

Larva. Immature caterpillars velvety black with four indistinct longitudinal white lines running the length of the body. Full grown larvae with shiny black mid-dorsal line, a sub-dorsal white line on either side beneath which are wide black bands. Beneath, the body varies from nearly black to gray. Length from one and one-half to one and three-quarters inches. (Fig. 23, C).

Pupa. About three-quarters of an inch in length; cremaster with pair of terminal spines.

Parasites

The following parasites have been recorded from this cutworm by other investigators: *Phorichacta (Scopolia) sequax* Will.; *Phorocera claripennis* Macq.; *Anthrax alternata* Say; *Psilocephala haemorrhoidalis* Macq.; and *Meteorus vulgaris* Cr. In addition the writer has reared the tachinid parasite *Ernestia ampelus* Wlk.

Agrotis normaniana Grt. This cutworm is found in Canada and in the United States from Maine south to New Jersey and westward to the Dakotas.

Food Plants. Our Maine records include blueberry *(Vaccinium canadense* and *V. pennsylvanicum),* pin or bird cherry *(Prunus pennsylvanica* L.), meadow-sweet *(Spiraea latifolia* Borkh.), wild raspberry (*Rubus* sp.), and sweet fern (*Myrica asplenifolia* L.).

Seasonal History and Importance. A few of the larvae were taken in October, 1927, at Winthrop, Maine, feeding at night on wild raspberry foliage. In the following spring several larvae were taken at night on blueberry plants near Brunswick. At that time, May 11 and 12, they were nearly full grown. In the spring of 1929 several specimens were collected near Brunswick on May 2, near Bath on May 10, and a few in North Sedgwick on May 16. One specimen molted on May 5 and pupated on June 17. The other specimens were all in the last larval instar when taken. Three of these, on which records were kept, pupated on June 24, June 29, and July 1, respectively.

On April 30, 1930, several more larvae were taken on wild cherry buds. One pupated on June 19 and emerged on July 18, while another pupated on June 26 and emerged on July 18.

Description of Stages

Adult. A light, yellowish-brown species; orbicular and reniform spots lighter, open above and separated by a brownish-black area; stigma of fore wing with black before it at apex. Hind wings fuscous bordered by a light brown fringe. Wing expanse 1⅞ to 1⅜ inches. (Fig. 15, G).

Larva. Body color reddish-brown with faint, subdorsal W-shaped markings. Length when full grown about 1¼ inches.

Pupa. Length 15 to 16 mm., width 4 to 4.5 mm. Cremaster distinct and armed with one pair of parallel, hooked, terminal spines which are black at base and brown at distal end. Also three pairs of spinules.

Parasites

The writer has reared two specimens of the tachinid, *Linnaemyia haemorrhoidalis* Fall, from larvae. The emergence of the adults took place on June 10 and June 14, 1929.

Agrotis oblata Morr. This is a northern species which occurs in Canada and in the United States from Maine and New York west to Colorado, Nevada, Utah, and California.

Food Plants. Our Maine feeding records for this species include blueberry *(Vaccinium canadense* and *V. pennsylvanicum),* and meadowsweet *(Spiraea latifolia).*

Seasonal History and Importance. A single specimen was taken in the larval stage on blueberry on May 10, 1929. This larva which was collected near Bath failed to molt after capture

and pupated on May 17, 1929. Therefore it must have passed the winter as a nearly full grown larva. The adult emerged on May 30, 1929, thus indicating a pupal period of around 13 days.

Description of Stages

Adult. Fore wings pinkish-brown, anal area and orbicular spot pinkish, orbicular large, oblique, and, like reniform, outlined in red and black. Hind wings light tan with border of similar shade. Wing expanse 1⅜ to 1½ inches. (Fig. 15, H).

Larva. Ground color of body yellowish with a series of conspicuous, black, sub-dorsal spots.

Pupa. Length 17 to 18 mm., width 5 to 6 mm. Cremaster armed with pair of parallel, terminal, hooked spines, dark at base and light brown at distal end; also two additional pairs of spinules.

Agrotis phyllophora Grt. This species is essentially northern in its range, occurring in Canada and in the northern United States from Maine, Massachusetts, and New York westward to Wisconsin. It assumed economic importance in certain Maine blueberry fields during 1929.

Food Plants. From the writer's observations in the field, wild cherry is apparently the favorite food plant. In addition the larvae under Maine conditions accept alder, birch, blueberry, Spiraea, Viburnum, and willow.

Seasonal History and Importance. A few nearly full grown larvae were collected on wild cherry buds on the Brunswick plains on the night of May 4, 1928. One of them pupated on May 20 and emerged on June 5. In 1929 over 80 specimens were collected in the same locality feeding on wild cherry and blueberry buds on the night of April 30, 1929. Because of their large size when the buds are swelling and their voracious feeding habits, these cutworms are doubtless of considerable importance during seasons of abundance. Of 79 larvae brought from the field to the laboratory in 1929, 69 were reared to maturity, one died of unknown cause, and the remaining nine were parasitized. None of the larvae molted after capture so they were all in the last larval instar when taken on April 30. All pupated between May 8 and May 12 and the 69 moths all emerged between May 27 and May 29. The average time spent in the pupal stage was approximately 16.5 days.

On April 30, 1930, a number of larvae were collected on wild cherry buds at Brunswick. It is interesting to note that pupation and emergence dates corresponded almost exactly with those of 1929. Pupation occurred from May 7 to May 12 and emergence from May 26 to May 31 according to records obtained from 14 individuals. However, the average duration of the pupal stage was about 19 days as compared with 16.5 days in 1929. On June 8, 1930, eggs were obtained from moths confined in cages. Many of these eggs hatched on June 16, the larvae then being transferred to individual breeding boxes.

Description of Stages

Adult. Fore wings purplish to reddish-gray, orbicular and reniform spots rufous, separated by dark brown cell. Hind wings dark. Wing expanse from 1⅜ to 1½ inches. (Fig. 15, I).

Larva. Body color reddish-brown with distinct white dorsal line extending length of body. Length about 1¼ inches when full grown. (Fig. 23, D).

Pupa. Length about 19 mm., width 5.5 mm. Cremaster distinct and roughened, and bearing pair of brown, terminal diverging spines.

Parasites

The writer reared nine tachinid flies of the species *Linnaemyia haemorrhoidalis* Fall[24] from larvae of this cutworm. Of the total group of 79 larvae, 11.4 per cent were parasitized by this tachinid. Six of the parasite larvae emerged from their hosts on May 5, one on May 6, one on May 12, and the last on May 13. The adult flies all emerged from their puparia on May 25.

Agrotis rubifera (Grt.) This cutworm is probably of slight economic significance under Maine conditions. The moth has a northern range and is apparently confined to the northern Atlantic States.

Food Plants, Seasonal History, Importance. The writer can say little regarding this insect and its habits since he has taken only a single specimen. This larva was collected at Brunswick on the night of May 12, 1928, in company with a number of larvae of the species *Agrotis normaniana.* It fed on blueberry in the

[24]Determined by Dr. J. M. Aldrich, Smithsonian Institute, Washington, D. C.

laboratory until it pupated on June 6. The adult moth emerged on June 25.

Description of Stages

Adult. Head, thorax and fore wing dull brown to purple-brown and bright chestnut red; orbicular and reniform spots fuscous with gray rings and blackish outlines. Hind wing ochreous gray, suffused with fuscous. Wing expanse 1¼ to 1½ inches.

Larva. Resembling *Agrotis normaniana* in size and appearance.

Noctua clandestina Harr. (*Agrotis unicolor* Wlk.), the Well-marked Cutworm. This species is one of our more destructive cutworms and likewise has a wide range of food plants. Distribution records include Greenland and, in the United States, Maine, New Jersey, Illinois, Wisconsin, and the Rocky Mountain region.

Food Plants. Crumb (1929, p. 141) lists the following food plants: apple, asparagus, bean, box elder, buckwheat, cabbage, cauliflower, celery, chickory, clover, corn, currant, gooseberry, grasses, lettuce, soft maple, peach, plantain, pumpkin, tobacco, and wheat. The writer also finds that it ascends certain shrubs in Maine including the various species of blueberry and huckleberry.

Life History and Importance. The well-marked cutworm is often present in great numbers in Maine blueberry fields in the early spring feeding upon the swelling buds and later on the leaves. In 1927 this cutworm in company with two other species (*Agrotis fennica* and *Polia purpurissata*) completely stripped a 50 acre blueberry field near Brunswick, Maine. This was a "new burn" field due to bear its first full crop after burning. As stated elsewhere the first crop after burning is always the heaviest and, unfortunately, the "new burn" fields are the only ones ever seriously attacked by cutworms so far as the writer knows. So complete was the destruction that the potential crop of 1000 bushels of berries, worth between $3000 and $4000, was wiped out in about 10 nights while the grower was out of town. The few berries present at picking time were so scattered that the owner did not attempt to pick the field at all. Many other similar instances could be cited for, in 1925, when the most widespread outbreak occurred, this species was found working in company with *Agrotis fennica* in a number of districts.

On May 11, 1925, a number of the nearly full grown larvae were taken in North Sedgwick. In early July a very heavy moth flight of this species was noted in that vicinity—in fact the moths became a nuisance in the homes of a number of blueberry growers for a period of about 10 days. Similarly, a second extremely heavy moth flight of this species took place about mid-September. The writer collected over 100 moths of this species in one shed loft in Orono alone. Eggs were deposited by some of the females on September 18 and 19 but they subsequently failed to hatch. Because of the appearance of these two widely separated moth flights during the same season, and the fact that egg-laying was taking place about the last of September, the writer is of the opinion that there is at least a partial second generation under Maine conditions.

On May 19, 1926, several lavae were taken in Brunswick feeding on blueberry. Two pupated on May 26 and on May 27 and 28 the others followed suit. Six moths emerged on June 12, the average duration of the pupal stage being from 15 to 17 days.

As stated above, these cutworms were present in great numbers in 1927 in the same vicinity. During that season pupation began on May 7 and emergence on May 27. The peak of emergence took place from June 16 to 18.

Description of Stages

Adult. Fore wings fuscous, reniform and orbicular spots concolorous with black outlines. Hind wings pale with dark veins and outer shade. Wing expanse 1½ to 1¾ inches.

Larva. Head brown, reticulate; body somewhat pinkish-brown with a series of segmentally arranged, subdorsal, black markings which unite to form W-shaped figures on the first eight abdominal segments. (Fig. 23, E).

Pupa. Length 16 mm., width 5 mm. Cremaster with a pair of long, pointed spines placed close together and with hooked accessory spinules.

Lycophotia astricta Morr. This is typically a northern species with a range including Newfoundland, Ontario, New Brunswick, Maine, and New York.

Food Plants. Our Maine records include alder *(Alnus incana)*, gray birch *(Betula populifolia)*, blueberry *(Vaccinium canadense* and *V. pennsylvanicum)*, wild cherry *(Prunus pennsylvanica)*, maple *(Acer* sp.), meadow-sweet *(Spiraea latifolia)*,

wild strawberry *(Fragaria* sp.), and Viburnum *(Viburnum cassinoides).*

Seasonal History and Importance. This has not been an important blueberry pest during the course of this investigation, but, in view of the fact that it is a large cutworm with an evident taste for the blueberry, it may appear in destructive numbers at any time. This, of course, is true of a number of the species described in this paper and for that reason a study of their habits and appearance is of value. The first captures were made in 1928 in Brunswick. Fifteen individuals were taken the following spring on May 2 and May 10, 1929, in fields near Brunswick and Bath. None of these was in the last instar when taken although all were in the next to last instar. A representative specimen molted on May 14, pupated on June 11, and emerged on June 28. It spent 27 days in the last instar and 17 days in the pupal stage.

On April 30, 1930, several specimens were collected on buds of wild cherry. The life history data are given in Table 2.

TABLE 2

Pupal and Emergence Records, 1930

Pupated	Emerged	Duration of Pupal Stage
May 29, 1930	June 19, 1930	21 days
May 31, 1930	June 21, 1930	21 days
May 31, 1930	June 23, 1930	23 days
May 31, 1930	June 23, 1930	23 days
May 31, 1930	June 20, 1930	20 days
June 4, 1930	June 27, 1930	23 days

The average duration of the pupal stage in 1930 was 21.8 days.

Description of Stages

Adult. Fore wings deep grayish-brown with distinct purplish cast suggestive of ground color of larva; orbicular and reniform spots outlined in dark purple. Hind wings brown with a lighter border or fringe. Wing expanse from 1½ to 2 inches. (Fig. 15, A).

Larva. Dark brown with a purplish cast; a series of black, subdorsal, segmental spots becoming larger at posterior end of body, also a similar series along each side. Length about 2 inches. (Fig. 24, B).

Pupa. Length 24 mm., width 7 to 8 mm. Cremaster with pair of stout spines.

Parasites

In June, 1928, the writer reared a number of braconid larval parasites from this cutworm. They were subsequently determined as *Apanteles griffini* Viereck.[85]

Lycophotia margaritosa saucia Haw., the Variegated Cut-Worm. The variegated cutworm, in common with other species having an extensive food range, is one of our most destructive forms. It has been recorded from the United States and Canada as well as from Europe, western Asia, North Africa, and the Canary Islands.

Food Plants. The variegated cutworm has an extremely wide range of food plants which include alfalfa, *Ambrosia artemisiaefolia,* apple, apricot, asparagus, beet, blackberry, box elder, cabbage, carrot, carnation, cedar, cherry, chickweed, chrysanthemum, clover, cocklebur, corn, cotton, cucumber, currant, dog fennel, Eupatorium, fireweed, gooseberry, grape, grass, hollyhock, honey locust, hop, jimson weed, knot grass, lemon tree, *Leptilon canadense,* lettuce, soft maple, mulberry, mustard, nettle, onion, orange leaves, osage orange, pansy, pea, sweet pea, peach, pink, *Plantago lanceolata,* plum, potato, prune, purslane, radish, raspberry, rhubarb, *Rhus copallina,* rose, *Rumex crispus,* rutabaga, sage, smilax, strawberry, sunflower, thistle, timothy, tobacco, tomato, turnip, violet, wheat, and willow. To the foregoing the writer can add the blueberry *(Vaccinium canadense, V. corymbosum* and *V. pennsylvanicum).*

Seasonal History and Importance. This species is one of our most destructive cutworms and numerous extremely widespread outbreaks have occurred in the United States and Canada. Under Maine conditions there are apparently two generations a year, the moths appearing in June and early July and again in late September. In 1925 a number of full grown larvae were collected feeding on tomatoes in a garden in Sargentville. A few days later (September 29) 17 pupae were collected in another tomato field in the same section. The moths began to appear on October 5, eight emerging between that date and October 8. Gibson (1915, p. 20) suggests the probability of two generations

[85]Determined by Dr. C. F. W. Muesebeck, Gipsy Moth Laboratory, Melrose Highlands, Massachusetts.

in Canada as follows: ".....the moths appearing in June and again about the middle of August."

Our attention was first called to the variegated cutworm as a pest of blueberry during the winter of 1928-29 when it attacked blueberry and tobacco plants which were being propagated in the Station greenhouse.

Description of Stages

Adult. Fore wings yellowish-brown, orbicular spot light, reniform filled with black. Hind wings light with veins and costal region fuscous, fringe white. Wing expanse 1½ to 2 inches. (Fig. 15, C).

Egg. White, circular, with flattened base, about 0.60 mm. wide and 0.40 to 0.45 mm. high.

Larva. Reddish-brown with a pale yellow dorsal line represented by a distinct yellow dot on each of the first four abdominal segments, subdorsal line composed of black spots bordered beneath by a pale yellowish line. From 1½ to 1¾ inches long when full grown.

Pupa. Length 17 to 22 mm., width 6 to 7 mm. Cremaster not pronounced, its apex smooth, armed with one pair sharp, gradually converging, terminal spines.

Parasites

The writer has not reared any parasites from this insect. Many dipterous and hymenopterous parasites have been bred from it by other workers, however.

Lycophotia occulta Linn., the Great Gray Dart Moth. This cutworm occurs in Asia, Northern and Central Europe, and North America. It is a distinctly northern species.

Food Plants. Lycophotia occulta does not appear to have an economic record in North America. Our Maine feeding records include blueberry *(Vaccinium canadense* and *V. pennsylvanicum),* and maple *(Acer* sp.). It is said to feed on a number of low plants in Europe.

Seasonal History and Importance. While this beautiful species has not been present in destructive numbers since the writer undertook this investigation it is an exceedingly voracious form and one potentially capable of great damage. A few larvae in the last instar were taken in 1928 in Brunswick and Monmouth. A representative specimen collected on May 12, pupated on May 20, and emerged as an adult on June 5. In 1929 a number of

last instar larvae were collected in Brunswick on May 2, in Bath on May 10, and in North Sedgwick on May 16. Many of these were parasitized by an undetermined tachinid. Pupation occurred from May 24 to May 30 and emergence from June 3 to June 9. The duration of the pupal period varied from about 15 days in 1928 to an average of only 10 days in 1929. There is probably but a single generation a season although this is not certain.

Description of Stages

Adult. Fore wings light gray, more or less suffused with dark gray; orbicular spot light gray, opening above, and dark outlined; reniform dark filled and often connected with orbicular by a black area; submarginal lines composed of large black and white teeth. Hind wings fuscous with white fringe. Wing expanse 2¼ to 2½ inches. (Fig. 15, B).

Larva. Brown with darker mottling; dorsal and subdorsal lines yellowish; spiracular line white; a series of dark, lateral, oblique stripes. Length when full grown about 2 inches. (Fig. 24, C).

Pupa. Length 24 to 27 mm., width 7 to 7.5 mm. Cremaster with one pair large, stout, black-knobbed spines.

Lampra brunneicollis Grt. The range of this cutworm includes New Brunswick, and the United States from Maine south to Massachusetts and New Jersey and westward to Wisconsin and Colorado.

Food Plants. It has been stated that the species feeds on numerous low plants. Our Maine records include blueberry *(Vaccinium pennsylvanicum)*, dandelion *(Taraxacum officinale)*, and sweet fern *(Myrica asplenifolia)*.

Seasonal History and Importance. This cutworm was first taken by the writer on May 11, 1928. At that time the larvae were all in the last larval instar. Pupation occurred from May 20 to May 30, 1928, and the moths emerged from June 13 to June 24. The 1929 moths emerged from June 9 to June 12. Thus from 18 to 25 days are spent in the pupal stage. *Lampra brunneicollis* may be said to be of economic importance in blueberry fields during certain seasons.

Description of Stages

Adult. Fore wings less than ¾ width of hind wings, grayish-brown with distinct, darker, interrupted, double transverse lines; orbicular and reni-

form spots distinct, light in color, and dark ringed; a fine black and white line at the base of the wings. Hind wings fuscous with paler tan borders. Wing expanse from 1¼ to 1½ inches.

Larva. Color soft, dark-brown with a series of subdorsal, segmental, black spots on the abdominal segments, these spots being uniform in size. Length when full grown from 1 to 1¼ inches. (Fig. 23, F).

Pupa. Length 16 to 17 mm., width 5 mm. Cremaster with one pair large, terminal spines and two pairs of spinules.

Parasites

The writer has reared several braconid wasp parasites from larvae of this species. The adult wasps emerged on May 25, 1928, and were determined by Dr. C. F. W. Muesebeck as a new species near *Apanteles scitulus* Riley.

Lampra minimalis Grt., the Lesser Red Dart Moth. This relatively unimportant species occurs in the United States from Maine to Colorado.

Food Plants. Blueberry *(Vaccinium pennsylvanicum)* is the only food plant noted in Maine.

Seasonal History and Importance. Little can be said concerning this insect since the writer has collected only one larva. That was taken feeding on blueberry buds in May, 1926, near Sebago Lake. The adult moth appeared on June 12, 1926.

Description of Stages

Adult. Head and thorax reddish-chestnut in color; fore wings chestnut-red lightly irrorated with black, orbicular and reniform spots with pale concentric rings and lower extremities black. Hind wings fuscous brown. Wing expanse about 1¼ inches.

Larva. Color uniformly dark brown. Length when full grown from 1⅛ to 1¼ inches.

Eueretagrotis perattenta Grt., the Two-spot Dart Moth. As in the case of the preceding species, this cutworm has no economic importance. It has been recorded from Montreal, Canada, to Maine, New York, south to Mississippi and Texas, and westward to Wisconsin.

Food Plants. Our records include blueberry *(Vaccinium pennsylvanicum)* on which our 1928 specimens were taken and subsequently reared, and wild cherry *(Prunus pennsylvanica).*

Seasonal History and Importance. It is evidently a relatively unimportant species in so far as the blueberry is concerned. In the spring of 1928 one larva was collected in Brunswick and from this a moth was reared. The larva pupated on May 25 and the moth emerged on June 13, indicating a pupal period of about 19 days.

In 1930 several larvae were collected on wild cherry *(Prunus pennsylvanica)* near Brunswick. Complete records were obtained on four individuals. Pupation occurred from May 10 to May 12 and emergence from May 26 to May 28. The average duration of the pupal period was 16.5 days.

Description of Stages

Adult. Fore wings dark grayish-brown, posterior transverse line single, subterminal area behind it purplish-brown; orbicular and reniform spots light in color, the former open above, the latter open below; the two separated by a blackish dash. Hind wings light, fringes paler. Wing expanse 1¼ to 1⅜ inches.

Larva. Somewhat resembling that of *Agrotis normaniana* with which it was confused at first. Body color reddish-brown, length about 1¼ inches.

Polia detracta Wlk. (=*clavipena* Grt.). This species first came to our attention as a blueberry pest in 1929 when two of the larvae were collected in a blueberry field near Bath. It occurs in Canada and throughout the eastern United States from Maine to Mexico.

Food Plants. Our Maine records include gray birch *(Betula populifolia),* blueberry *(Vaccinium canadense* and *V. pennsylvanicum),* dandelion *(Taraxacum officinale),* and service berry *(Amelanchier spicata).* It is said to feed upon a variety of low plants.

Seasonal History and Importance. Only two specimens have been taken during the course of this study; hence this species cannot be classed with the more destructive blueberry cutworms. The larvae in question were taken in a large blueberry field near Bath on the night of May 10, 1929. Both were in the last instar when taken. One pupated on May 22 the other on May 27. The former was preserved in the pupal stage while the other emerged on June 9. Thus the length of the pupal stage was 13 days in the case of the individual noted.

Description of Stages

Adult. Fore wings dingy gray in color dusted with dark brown, reniform and orbicular spots light with dark borders; also coniform macula with black outline in each fore wing. Hind wings blackish brown. Wing expanse about 1⅛ inches.

Larva. Reddish-brown in color with fine, light longitudinal lines and a light brown dorsal area. Length about one inch.

Pupa. Length 16 to 17 mm., width 5 mm. Cremaster with a number of sharply pointed, terminal spines, also many tubercles with short, stout spines scattered over the abdominal segments, dorsally.

Polia lorea Gn. (= *ligata* Wlk. and *dodgei* Morr.). This interesting cutworm was present in Maine blueberry fields in some numbers during the spring of 1929 but it apparently preferred Spiraea and sweet fern to blueberry. The moths have been taken in Canada and in the United States, from Maine to Colorado.

Food Plants. Gray birch *(Betula populifolia),* blueberry *(Vaccinium pennsylvanicum),* wild cherry *(Prunus pennsylvanica),* meadow-sweet *(Spiraea latifolia),* sweet fern *(Myrica asplenifolia),* and withe-rod *(Viburnum cassinoides).*

Seasonal History and Importance. The writer collected this climbing cutworm in various parts of Maine in 1929. Larvae were taken near Brunswick on May 2, near Bath on May 13, and in North Sedgwick on May 16. Thus far it has not been found on blueberry in destructive numbers.

TABLE 3

Pupal and Emergence Records

Pupated	Emerged	Duration of Pupal Stage
May 16, 1929	May 31, 1929	15 days
May 16, 1929	May 31, 1929	15 days
May 17, 1929	May 30, 1929	13 days
May 19, 1929	May 31, 1929	12 days
May 20, 1929	May 31, 1929	11 days
May 24, 1929	June 8, 1929	15 days
May 29, 1929	June 14, 1929	16 days

On the basis of the above records the average time spent in the pupal stage was about 14 days. The moths of this species and of *Agrotis phyllophora* are among the earliest to emerge.

In 1930 a few more of these cutworms were collected near Brunswick on wild cherry. Pupal and emergence records corresponded closely with those obtained the preceding season.

Description of Stages

Adult. Fore wings light reddish-brown, the discal area suffused with deeper red; orbicular and reniform spots grayish margined with dark brown, the reniform with lower part black. Hind wings yellowish brown. Wing expanse 1 to 1⅛ inches. (Fig. 16, B).

Larva. Light yellowish-brown with a series of darker diamond-shaped spots along dorsum. Length about 1 inch. (Fig. 24, D).

Pupa. Length 15 to 16 mm., width 5 mm.; cremaster dark, rugulose and with one pair long, brown, parallel, sharply pointed, terminal spines.

Parasites

The writer reared two tachinid fly parasites *(Linnaemyia haemorrhoidalis* Fall and *Peleteria apicalis* Wlk.[36]) from larvae of this species.

Polia purpurissata Dru. Under Maine conditions *Polia purpurissata* is one of the outstanding blueberry cutworms. The larvae appear locally nearly every spring and are extremely voracious. The insect has been taken in Canada and in the United States from Maine to New York and westward to Utah.

Food Plants. This cutworm has been taken in the fields feeding upon blueberry *(Vaccinium canadense* and *V. pennsylvanicum)* and sweet fern *(Myrica asplenifolia).* In addition it readily accepted the following plants in the laboratory: Alder *(Alnus* sp.), gray birch *(Betula populifolia),* ground ivy *(Nepeta hederacea),* maple *(Acer* sp.), meadow-sweet *(Spiraea latifolia),* poplar *(Populus* sp.), rhododendron *(Rhododendron rhodora),* wild strawberry, sweet fern *(Myrica asplenifolia),* willow *(Salix* sp.), and withe-rod *(Viburnum cassinoides).*

Seasonal History and Importance. Polia purpurissata is one of the most voracious and destructive of the many blueberry-infesting cutworms. Collections were first made in Maine in 1926 in the vicinity of Brunswick where these cutworms, in company with black army cutworms and W-marked cutworms, were stripping the blueberry buds in a number of localized areas. Owing to

[36]Determinations by Dr. J. M. Aldrich, Smithsonian Institute, Washington, D. C.

parasitism and disease the writer was unable to rear any of the larvae through to the adult stage that season. The following spring this cutworm was present in "new burn" fields in the same territory in great numbers. Its attack proved to be exceedingly harmful. For example, a 50 acre field which had been burned in 1926 was so completely denuded in 1927 that no attempt was made at picking time to harvest the few berries produced by the buds which escaped.

Over a hundred larvae were taken in the spring of 1928, mainly in the third or fourth instars. Many of them molted on May 8 and after a period of six or seven days the final molt occurred. This species spends an unusually long period in the last larval instar and likewise in the pupal stage.

TABLE 4

Pupal and Emergence Records

No. Pupated	No. Emerged	Duration of Pupal Stage
7 on June 10, 1928	7 on July 26	46 days
1 on June 10, 1928	1 on July 20	40 days
5 on June 10, 1928	5 on Aug. 6	57 days
1 on June 13, 1928	1 on Aug. 6	54 days
1 on June 14, 1928	1 on Aug. 6	53 days
2 on June 15, 1928	2 on Aug. 6	52 days
2 on June 18, 1928	2 on July 27	39 days

On the basis of the above records this cutworm spends about 25 days in the last larval instar and about 48 days in the pupal stage. There was an apparent tendency for the males to emerge first as evidenced by the fact that they pupated sooner and, with one or two exceptions, emerged four to five days earlier. Of 59 moths reared in 1928 there were 29 males and 30 females, a practically equal distribution of the sexes.

Description of Stages

Adult. A large species with purple to reddish-gray fore wings, darker brown along costal margins, double dentate lines filled between with lighter gray; orbicular and reniform spots light in color and outlined in dark brown. Hind wings reddish-brown, darker toward margins, fringes white. Wing expanse 1½ to 1¾ inches. (Fig. 16, C).

Larva. Reddish-brown without conspicuous markings. Length when full grown nearly 2 inches. (Fig. 24, E).

Pupa. Length 26 to 28 mm., width 7.5 to 8 mm.; cremaster distinct, black, rugulose with one pair stout, light-brown, terminal, knobbed spines, widely separate at base; additional knobbed spinules.

Parasites

The writer has reared the tachinid fly *(Linnaemyia haemorrhoidalis* Fall) from larvae of this cutworm; also several parasitic wasps determined by Mr. R. A. Cushman as *Zele* n. sp.

Polia subjuncta G. and R. The larvae of this species evidently prefer the ripe blueberries to the foliage. The moths have been taken in Canada and in the United States, from Maine to New Mexico.

Food Plants. Our Maine records include only the fruit and foliage of the blueberry *(Vaccinium canadense, V. corymbosum,* and *V. pennsylvanicum).*

Seasonal History and Importance. This is an unimportant species in so far as our Maine records are concerned. We collected one larva at North Gray on July 24, 1929, on blueberry. It molted for the last time on August 17 and pupated on September 6. The moth emerged in the laboratory on March 1, 1930. A second larva was taken at Harrington, Maine, on August 23, 1929, feeding on blueberry fruit *(Vaccinium pennsylvanicum).* It continued to feed on the fruit and later on the foliage (Fig. 24, F) until early in October when it died. The larvae are day feeders and are not cutworm-like in appearance.

Description of Stages

Adult. Fore wings purplish-gray dusted with red-brown, especially behind the reniform spot as far as the apex, orbicular spot grayish with dark border and open above. Hind wings lighter grayish-brown with veins and fringes darker. (Fig. 16, A).

Larva. Greenish in color watered with brown; has broad, distinctive reddish lateral bands bordered above with yellow. Length when full grown about 1½ inches. (Fig. 24, F).

Pupa. Length 18 mm., width 6 mm.

Ceramica picta Harr., the Zebra Caterpillar. This well known garden pest occurs in the United States from the Atlantic States

to Colorado. A number of larvae were collected on high bush blueberry *(Vaccinium corymbosum)* in York County, Maine, on July 19, 1929. Several larvae were later reared to maturity on blueberry. The caterpillars, when full grown, are yellow in color with a broad, black dorsal stripe and two black lateral stripes. (Fig. 24, A). The latter are interrupted by numerous white lines. The moths have dark-brown fore wings and pale yellow hind wings. (Fig. 16, G).

Calocampa cineritia Grt. The larvae of this noctuid are day feeders which become fully developed in midsummer. Distribution is confined to the north Atlantic States.

Food Plants. This cutworm is said to feed on low plants in general. We have taken it in the fields feeding only on blueberry *(Vaccinium canadense* and *V. pennsylvanicum).*

Seasonal History and Importance. The writer collected two larvae at North Gray on June 26, 1929. Both molted on July 8 and by August 2 had ceased feeding. The larvae were at that time about an inch and a half in length and red in color. Pupation occurred on August 23 and the moths emerged on October 3 and October 5 respectively. The duration of the pupal period in the case of these two individuals was thus about six weeks. Evidently there is but one generation a season. During the course of this investigation this insect has not appeared in destructive numbers.

Description of Stages

Adult. Thorax and fore wings dark brown to black; light brown area near apex of fore wings; hind wings dark fuscous. Wing expanse from 1½ to 1¾ inches. (Fig. 16, E).

Larva. Reddish-brown in color without distinctive markings. Length about 1½ inches when full grown.

Pupa. Length 22 to 24 mm., width 6.5 to 7 mm.; cremaster black with one pair of stout, terminal spines.

Scopelosoma (Conistra) walkeri Grt. The record of this insect as a blueberry pest is based on a single larva taken in 1929. It is said to occur throughout the Atlantic States.

Food Plants. This species was taken feeding on blueberry *(Vaccinium pennsylvanicum)* on which it was subsequently reared to maturity. It is said to feed on various low plants.

Seasonal History and Importance. This is likewise an apparently unimportant species. A single larva was taken at North Sedgwick on June 22, 1929, feeding on a blueberry plant. Pupation occurred on August 12 and the moth emerged on October 5. Thus nearly seven weeks were spent in the pupal stage by the specimen in question. There is evidently only one generation a year.

Description of Stages

Adult. Fore wings ochreous brown with apex of each pointed forward; orbicular spot small, indistinct, reniform larger and light in color; submarginal area dark brown. Hind wings small in proportion to fore wings, costal area and fringe light in color; rest of wings fuscous with dark markings. Wing expanse 1⅜ inches. (Fig. 16, F).

Larva. Dark reddish-brown with indistinct light dorsal and subdorsal lines. Length 1⅛ to 1¼ inches.

Pupa. Length 14 mm., width 5 to 5.5 mm.; cremaster black with one pair of black, terminal spines and other brown spinules.

Acronycta distans Grt. This is likewise a relatively unimportant blueberry pest. The moths have been recorded from Canada and New York.

Food Plants. Our only record is that of blueberry *(Vaccinium pennsylvanicum)* on which the caterpillars were taken in the field and later reared to maturity.

Seasonal History. Several of the distinctly woolly caterpillars were collected feeding on blueberry leaves in Hancock County, Maine, on July 8, 1929. Two of these larvae pupated on July 18. One subsequently emerged as an adult moth on July 30, 1929. It is probably an unimportant pest.

Description of Stages

Adult. Fore wings brownish-gray with indistinct dark markings; orbicular spot with black center and outlined in black; outer margins white interrupted by black vein endings. Hind wings fuscous with white fringes. (Fig. 16, I).

Larva. Distinctly hairy with red tufts on segments 2 to 5 and 12 and 13; other tufts light yellow. Length when full grown about 1¼ inches.

Parasites

The writer reared a number of parasitic wasps from the larvae. They were determined by Dr. C. F. W. Muesebeck as *Apanteles coxalis* Mues. The adult braconid wasps emerged on July 29, 1929.

Hyppa xylinoides Grt. This is an interesting species which may have two generations a season in Massachusetts. It is apparently confined to the Atlantic States.

Food Plants. The larvae readily accepted leaves of blueberry *(Vaccinium corymbosum* and *V. pennsylvanicum)* on which they were fed in the laboratory.

Seasonal History. While visiting the Massachusetts Cranberry Substation at East Wareham, Massachusetts, on August 8, 1929, the writer took a female moth of this species in a planting of high bush blueberry *(Vaccinium corymbosum).* In the laboratory, eggs were subsequently laid and the majority of these hatched on August 17. The first molt occurred on August 25, the second on August 31, the third on September 4, and in the case of some of the larvae, records were kept until some of the insects were in the sixth instar. At that time (early October) it was impossible to get any except dry foliage and the larvae failed to mature because of it. The adult moth has brownish-gray fore wings with dark shading along the inner margins to base; conspicuous white markings near lower part of outer margins of fore wings. Hind wings fuscous with narrow white fringes. Wing expanse about one and one-half inches. (Fig. 15, K).

Drasteria graphica atlantica B. and McD. During the spring of 1926 the writer reared one moth of this species from a collection of pupae taken in a blueberry field near Sebago Lake. There was nothing to indicate whether the larva had fed on blueberry or on some other plant growing in the same field.

In 1927 a very severe outbreak of looping worms occurred in certain blueberry fields in western Maine. One grower, in particular, suffered a loss of approximately 1500 bushels of berries valued roughly at $5000. Because of his extensive holdings the owner did not discover the presence of the worms until they were practically through feeding. By the third week in June, 1928, moths of the species *Drasteria graphica atlantica* B. and

McD. were present by the millions in the territory infested the previous summer. Unfortunately, the previous attacks of this species, due to an erroneous determination, were published under the name *Syneda alleni* (Phipps, 1929).

Nature of Injury. The outbreak of 1927 occurred in midsummer and attained its height just prior to picking time. The caterpillars were most numerous about the last of July and they ate leaves, green and ripe berries, and even the bark. Many other plants in the fields were stripped in addition to blueberry. Defoliation occurred so late in the season that the plants had no opportunity to recover and consequently they produced no fruit buds for the following season. Thus a practically complete crop loss for two seasons resulted.

Description of Stages

Adult. Fore wings dark-brown, hind wings rusty yellow bordered on outer margins with dark-brown bands; fore wings with transverse anterior bands regular and not wavy as in *Syneda alleni.* Day fliers. Males with penciled olfactory tufts on fore legs. Wing expanse 1⅜ to 1½ inches. (Fig. 16, D).

Egg. Spherical, light gray in color, and faintly reticulated; about .42 mm. in diameter.

Larva. Body slender and possessing but three pairs of functional prolegs, two pairs rudimentary. Very active, jumping from plant to plant when disturbed. Day feeders. Light gray without distinct markings in first instar, later becoming darker with a brownish cast. Full grown larvae with wide, dark-brown dorsal stripe, narrower and lighter colored subdorsal areas faintly mottled with wavy reddish lines; spiracular bands dark-brown. Ventral area lighter in color mottled with reddish lines. Length when full grown about one inch.

Pupa. Length 7 to 8 mm., width 2 to 2.5 mm.; cremaster with 4 pointed terminal spines.

Parasites

A parasitic wasp determined by Mr. R. A. Cushman as *Sesioplex validus* (Cress.) was reared from one of the larvae.

Seasonal History. The moths emerge from the overwintering pupae early in June and are present in the fields for about a month. Moths taken in the field on June 21 began egg-laying in captivity on June 28. The first larvae hatching from these were observed on July 4 and by July 10 all the eggs had hatched. On

July 11 many first and second instar larvae were found in the field and by that date very few of the parent moths could be found. The total period of larval development from egg-hatching until pupation was between eight and nine weeks.

Control Experiments. Spraying: Preliminary experiments in the use of lead arsenate applied at the rate of one and one-half pounds in 50 gallons of water gave good control of the small larvae.

Baiting: The abundance of the moths afforded an excellent opportunity to test various attrahent baits. We employed as containers enameled quart-and-a-half stew-pans. These pans were then half filled with the attracting liquid and placed at intervals of 25 or 30 feet in one corner of the field.

The best results were obtained from pans containing fermenting bait composed of light Karo syrup (one part in 12 parts of water), yeast, and a small quantity of honey. At the end of one week these pans were examined and gave an average catch of 90.8 moths per pan. Another series containing the same ingredients with the exception of honey yielded 53.7 moths per pan. One series of 15 pans examined twice gave a total catch of nearly 3,000 moths. While this experiment was not extensive it was suggestive enough to encourage further trial.

Pangrapta decoralis Hbn. This is the smallest noctuid recorded from blueberry in this paper. The tiny moths which have the fore and hind wings similarly marked, occur throughout the Atlantic States.

Food Plants. High bush blueberry *(Vaccinium corymbosum).*

Seasonal History and Descriptions. A single larva was collected on high bush blueberry in Orono, Maine, on July 27, 1929. Pupation occurred on August 24, 1929, and a moth emerged in the laboratory on March 1, 1930. The larva is very small and light green in color. The wing expanse of the moth is about 13/16 of an inch. Both fore and hind wings are light brown in color, watered with darker brown, and are somewhat similarly marked. (Fig. 16, H). The pupa is about 10 mm. long by 3 mm. wide. The cremaster is black and possesses a pair of black, curved terminal spines, also a pair of brownish spinules.

NOTODONTIDAE—The Prominents

Schizura unicornis S. and A., the Unicorn Prominent. This insect occurs in Canada and in the United States from Maine westward to Minnesota. The larvae are said to feed on a variety of plants and trees including apple, blackberry, dogwood, elder, plum, raspberry, rose, and wintergreen.

A single larva collected on blueberry *(Vaccinium pennsylvanicum)* in Orono, Maine, in August, 1929, became full-fed on a blueberry foliage diet and pupated on September 5, 1929. The moth emerged in the laboratory on December 20, 1929.

ARCTIIDAE—The Woolly Bears and Tiger Moths

Estigmene acraea Dru. Commonly known as the salt marsh caterpillar, this species occurs throughout the United States and Canada. The fully developed larvae are called "woolly bears" because of their dense covering of long, reddish-brown hairs. They feed on bean, cotton, pea, and many other plants.

During the 1929 season this caterpillar was unusually abundant in Maine on clover and garden plants. About 50 of the small second instar larvae were transferred to blueberry in the laboratory and they appeared to thrive on it for they molted several times and eventually pupated. There is but one generation a season under Maine conditions, winter being spent in the pupal stage. The moths were present in abundance from June 15 to June 30, 1929, according to data based on our light trap captures. Many larvae were in the second instar about July 1 and in the last instar by August 1, 1929. Pupation was at its height around September 1. If artificial control measures should be necessary either spraying or dusting with lead arsenate will give control.

PAPILIONIDAE—The Swallow-tails

Papilio glaucus turnus Linn., the Tiger Swallow-tail. This common insect occurs throughout the Atlantic States and in parts of Canada. A single larva was collected on blueberry *(Vaccinium pennsylvanicum)* by the writer in 1928. It subsequently fed on the leaves of blueberry in the laboratory for several days and then molted. However, it died before pupation occurred and no

other specimens were taken. Wild cherry and lilac are among the common food plants.

HYMENOPTERA—The Wasps and Related Insects

TENTHREDINIDAE—The Sawflies

The writer collected two species of sawfly larvae feeding on blueberry leaves during 1929. One species was present in great numbers in one field, the larvae stripping nearly 50 acres of plants. When full grown the larvae were about three-eighths of an inch in length and dark green in color. The larva of the second species was similar in appearance except that it had a conspicuous, white dorsal stripe.

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CATALOG OF INSECTS INJURIOUS TO BLUEBERRY AND HUCKLEBERRY

The following catalog lists the blueberry and huckleberry insects studied by the writer and also those insects and mites noted by other investigators as frequenting these plants. The records, aside from those of the writer, have, therefore, been assembled in the main by consulting publications, in various languages, containing biological data on insects and plants. While many pub-

lications have been consulted in preparing this catalog it is of necessity incomplete since it would be impossible to locate all papers which might contain pertinent material. However, it is hoped that it will serve a useful purpose as a background for further investigation.

The catalog lists 292 species, representing 9 orders and 57 families as follows:

Acarina, 3 species:	
Eriophyidae	1
Oribatidae	1
Tetranychidae	1
Orthoptera, 14 species:	
Tettigoniidae	2
Gryllidae	2
Locustidae	10
Hemiptera, 22 species:	
Miridae	9
Nabidae	1
Lygaeidae	5
Coreidae	1
Pentatomidae	6
Homoptera, 28 species:	
Cicadidae	1
Cercopidae	2
Cicadellidae	6
Fulgoridae	1
Aphididae	5
Coccidae	13
Thysanoptera, 2 species:	
Aeolothripidae	1
Thripidae	1
Coleoptera, 31 species:	
Anthribidae	1
Lampyridae	1
Scarabeidae	4
Cerambycidae	1
Chrysomelidae	6
Curculionidae	17
Scolytidae	1
Diptera, 16 species:	
Cecidomyiidae	13
Trypetidae	2
Drosophilidae	1
Lepidoptera, 172 species:	
Nepticulidae	1
Limacodidae	1
Tineidae	2
Gracilariidae	4
Coleophoridae	1
Elachistidae	1
Heliozelidae	1
Gelechiidae	8
Eucosmidae	2
Tortricidae	27
Pyralididae	5
Sphingidae	4
Geometridae	30
Nolidae	1
Lymantriidae	4
Noctuidae	59
Notodontidae	6
Arctiidae	1
Zygaenidae	1
Saturniidae	3
Lasiocampidae	3
Papilionidae	1
Pieridae	1
Nymphalidae	2
Lycaenidae	3
Hymenoptera, 4 species:	
Tenthredinidae	2
Cynipidae	1
Miscogasteridae	1

ACARINA

depressa Bks., *Galumna* Fam. *Oribatidae*

Hosts—*Vaccinium corymbosum.*

Injury—Not stated.

Distribution—New York, New Jersey, and Washington, D. C.

Reference—Weiss, Harry B. Additional records of New Jersey Acarina. Ent. News 27: 109. 1916.

monticolus McGregor, *Tetranychus* Fam. *Tetranychidae*

Hosts—Large-berried blueberry, *Vaccinium* sp.

Injury—Discoloration of leaves followed by dropping.

Distribution—Mount Hood, Oregon.

Reference—McGregor, E. A. Descriptions of seven new species of red spiders. Proc. U. S. Nat. Mus. 51: 581-590. 1917.

Eriophyes sp. Fam. *Eriophyidae*

Hosts—Blueberry.

Injury—Produces small round galls on the leaves.

Distribution—Washington.

References—Felt, E. P. Key to American Insect galls, p. 177.
Chadwick, G. H. A catalogue of the "Phytoptid" galls of North America. New York State Mus. Bul. 124: 156. 1908.

ORTHOPTERA

apiculatus Harr., *Hippiscus* Fam. *Locustidae*
(see page 118)

bivittatus (Say), *Melanoplus* Fam. *Locustidae*
(see page 118)

carolina (Linn.), *Dissosteira* Fam. *Locustidae*
(see page 118)

conspersa Harr., *Chloealtis* Fam. *Locustidae*
(see page 118)

cristatus cristatus (Scudder), *Nomotettix* Fam. *Locustidae*
(see page 118)

curtipennis (Harr.), *Chorthippus* Fam. *Locustidae*
(see page 119)

curvicauda borealis (Hebard), *Phaneroptera* Fam. *Tettigoniidae*
(see page 117)

fasciatus (?) (F. Walker), *Melanoplus* Fam. *Locustidae*
(see page 118)

fasciatus fasciatus (De Geer), *Nemobius* Fam. *Gryllidae*
(see page 117)

keeleri luridus (Dodge), *Melanoplus* Fam. *Locustidae*
(see page 119)

marmorata (Harr.), *Scirtettica* Fam. *Locustidae*
(see page 119)

niveus De Geer, *Oecanthus* Fam. *Gryllidae*
(see page 118)

pellucida (Scudder), *Camnula* Fam. *Locustidae*
(see page 119)

pistillata (Brunner), *Phaneroptera* Fam. *Tettigoniidae*
(see page 117)

HEMIPTERA

accerra McAtee, *Thyanta* Fam. *Pentatomidae*
Hosts—Huckleberry.
Injury—Swept from leaves.
Distribution—Florida.
Reference—Blatchley, W. S. Heteroptera of eastern North America, p. 118. 1926.

albohirtus Knight, *Sixeonotus* Fam. *Miridae*
Hosts—Low blueberry, low huckleberry.
Injury—On leaves.
Distribution—Sanford, Florida.
Reference—Blatchley, W. S. Heteroptera of eastern North America, p. 874. 1926.

bicrucis Say, *Lygaeus* Fam. *Lygaeidae*
Hosts—Low huckleberry.
Injury—Attacks flowers.
Distribution—New Jersey, Pennsylvania, Maryland, North Carolina, Georgia, Florida, Louisiana, Missouri, Kansas, Colorado, Texas, Arizona, and California.
Reference—Blatchley, W. S. Heteroptera of eastern North America, p. 347. 1926.

delius (Say), *Coenus* Fam. *Pentatomidae*
(see page 119)

dimidiata (Say), *Banasa* Fam. *Pentatomidae*
(see page 120)

ericae (Schill.), *Nysius* Fam. *Lygaeidae*
(see page 120)

euschistoides (Voll.), *Euschistus* Fam. *Pentatomidae*
(see page 120)

femorata (Fab.), *Acanthocephala* Fam. *Coreidae*
Hosts—Low huckleberry.
Injury—Attacks flowers.
Distribution—North Carolina, South Carolina, Georgia, Louisiana, Florida, Oklahoma, and Texas.
Reference—Blatchley, W. S. Heteroptera of eastern North America, p. 216. 1926.

fraternus var. *discifer* Knight, *Platytylellus* Fam. *Miridae*
Hosts—Low huckleberry.
Injury—Swept from leaves.
Distribution—Connecticut, Florida, and Maryland.
Reference—Blatchley, W. S. Heteroptera of eastern North America, p. 687. 1926.

insignis (Uhl.), *Sphaerobius* Fam. *Lygaeidae*
(see page 120)

instabilis (Reut.), *Lopidea* Fam. *Miridae*
(see page 121)

intercidendus (Distant), *Platytylellus* Fam. *Miridae*
Hosts—Low huckleberry.
Injury—On leaves.
Distribution—Florida and California.
Reference—Blatchley, W. S. Heteroptera of eastern North America, p. 684. 1926.

kalmii Stal, *Lygaeus* Fam. *Lygaeidae*
(see page 121)

lenticularis Uhl., *Banasa* Fam. *Pentatomidae*
Hosts—Huckleberry.
Injury—On leaves.
Distribution—Florida.
Reference—Blatchley, W. S. Heteroptera of eastern North America, p. 166. 1926.

psalliodes Reut., *Parthenicus* Fam. *Miridae*
Hosts—Blueberry.
Injury—On leaves.
Distribution—New York, New Jersey, Pennsylvania, Ohio, Kansas, Colorado, Texas, and California.
Reference—Blatchley, W. S. Heteroptera of eastern North America, p. 805. 1926.

rapidus (Say), *Adelphocoris* Fam. *Miridae*
(see page 121)

rubrinervis (Stal), *Creontiades* Fam. *Miridae*
Hosts—Low huckleberry.
Injury—Feeds on leaves.
Distribution—Florida and California.
Reference—Blatchley, W. S. Heteroptera of eastern North America, p. 732. 1926.

rubrovittatus (Stal), *Platytylellus* Fam. *Miridae*
(see page 121)

rufusculus Reut., *Nabis* Fam. *Nabidae*
Hosts—Vaccinium canadense, V. pennsylvanicum.
Injury—Eggs laid in green and ripe berries.
Distribution—Canada, and the United States from Maine south to Massachusetts, Connecticut, Maryland, Virginia, and west to Illinois, Wisconsin and Colorado.
Reference—Woods, W. C. Blueberry insects in Maine. Me. Agr. Expt. Sta. Bul. 244: 283-285. 1915. illus.

sylvestris Linn., *Ligyrocoris* Fam. *Lygaeidae*
(see page 121)

uhleri Stal, *Chlorochroa* Fam. *Pentatomidae*
(see page 120)

vaccinii (Van D.), *Parthenicus* Fam. *Miridae*
Hosts—Blueberry and cranberry *(V. macrocarpon).*
Injury—Attack foliage.
Distribution—Connecticut, New York, Florida, and Massachusetts.
Reference—Blatchley, W. S. Heteroptera of eastern North America, p. 806. 1926.

HOMOPTERA

azaleae Comst., *Eriococcus* Fam. *Coccidae*
Hosts—Azalea, *Crataegus coccinea,* huckleberry, *Rhododendron catawbiense.*
Injury—Attacks stems.
Distribution—New York, Massachusetts, District of Columbia, Ohio, and Michigan.
References—Fernald, Mrs. Maria E. A catalogue of the Coccidae of the world, p. 72. 1903.
Leonard, M. D. A list of the insects of New York, p. 194. 1926.

bivittata (Say), *Acanalonia (Amphiscepa)* Fam. *Fulgoridae*
Hosts—Cranberry, *Vaccinium corymbosum.*
Injury—Egg punctures in the wood.
Distribution—Canada and the United States from Maine south to Florida, Arkansas, and Texas, and west to Ohio, Iowa, Wisconsin, and Minnesota.
Reference—Scammel, H. B. *Amphiscepa bivittata* Say, in its relation to cranberry. Jour. econ. ent. 10: 552-556. 1917.

borealis Mason, *Amphorophora* Fam. *Aphididae*
(see page 124)

coryli (Linn.), *Eulecanium (Physokermes)* Fam. *Coccidae*
Hosts—*Corylus avellana,* Cotoneaster, currant, gooseberry, raspberry, *Vaccinium myrtillus.*
Injury—Attacks stems and shoots sucking sap from them.
Distribution—England, Denmark, Italy, and North America.
References—Fernald, Mrs. Maria E. A catalogue of the Coccidae of the world, p. 185. 1903.
Silvestri, F. (letter of March 28, 1929).

distinguendum (Dougl.), *Eulecanium* Fam. *Coccidae*
Hosts—Sarcothamnus, *Vaccinium myrtillus.*
Injury—Sucks sap from stems and leaves.

Distribution—England.
Reference—Fernald, Mrs. Maria E. A catalogue of the Coccidae of the world, p. 186. 1903.

ericae Loew., *Pulvinaria* Fam. *Coccidae*
Hosts—*Erica carnea, Vaccinium myrtillus, V. vitis-idaea.*
Injury—Attacks stems sucking sap from them.
Distribution—Austria, Bohemia, and Denmark.
References—Fernald, Mrs. Maria E. A catalogue of the Coccidae of the world, p. 132. 1903.
Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 334. 1874.

gothica (Sign.), *Cicadella* Fam. *Cicadellidae*
(see page 123)

kingii (Ckll.), *Eulecanium* Fam. *Coccidae*
Hosts—*Vaccinium corymbosum.*
Injury—Attacks stems.
Distribution—Massachusetts.
References—Felt, E. P. Insects affecting park and woodland trees. New York State Mus. Mem. 8, Vol. 2, p. 739. 1906.
Fernald, Mrs. Maria E. A catalogue of the Coccidae of the world, p. 189. 1903.

lateralis (Fab.), *Oncometopia* Fam. *Cicadellidae*
(see page 123)

luzulae (Dufour), *Luzulaspis* Fam. *Coccidae*
Hosts—*Luzula angustifolia, L. campestris, L. maxima, L. pilosa, Vaccinium myrtillus.*
Injury—Attacks stems.
Distribution—England, Scotland, France, and Australia.
Reference—Lindinger, L. Die Schildläuse, p. 207. 1912.

myscellus Ball, *Deltocephalus* Fam. *Cicadellidae*
(see page 124)

nigrofasciatum (Perg.), *Eulecanium* Fam. *Coccidae*
Hosts—Apple, birch, blueberry, linden, maple, olive, peach, plum, sycamore.
Injury—Sucks sap from stems and secretes sticky fluid.
Distribution—Canada and the United States south and west to Florida and Minnesota.
References—Britton, W. E. *Eulecanium nigrofasciatum* Perg. (terrapin scale) on blueberry in Connecticut. *In* Conn. Agr. Expt. Sta. Bul. 234: 183. 1922.
Fernald, Mrs. Maria E. A catalogue of the Coccidae of the world, p. 191. 1903.

octolineata var. *striata* Burm., *Gypona* Fam. *Cicadellidae*
(see page 124)

perniciosus Comst., *Aspidiotus* (San Jose scale) Fam. *Coccidae*
Hosts—Many fruit and shade trees and plants including English huckleberry.
Injury—Sucks juices from bark, fruit, and leaves.
Distribution—Asia, North America, South America, Europe, Australia, and Hawaii.
Reference—Howard, L. O. The San Jose scale in 1896-1897. U. S. Dept. Agr. Div. Ent. (new series) Bul. 12: 13. 1898.

proteus Fitch, *Clastoptera* Fam. *Cercopidae*
(see page 122)

proteus var. *vittata* Ball, *Clastoptera* Fam. *Cercopidae*
Hosts—Vaccinium and Gaylussacia, Andromeda, Leucothoe, Cassandra.
Injury—Egg punctures on stems and sucking of sap by nymphs and adults. Often results in killing back the plants.
Distribution—Maine, New Hampshire, Massachusetts, Ohio, Wisconsin, etc.
References—Franklin, H. J. Seventh report of the cranberry substation. Mass. Agr. Expt. Sta. Bul. 192: 127. 1919.
Stearns, L. A. Family Cercopidae. *In* The Hemiptera of Connecticut, p. 234. 1923.

rugosa Spongb., *Gypona* Fam. *Cicadellidae*
Hosts—Whortleberry bushes.
Injury—Suck juices from plant.
Distribution—Canada and in the United States from New York, Pennsylvania, New Jersey, Ohio, Kentucky, Florida, Tennessee, Mississippi, and Mexico.
Reference—Osborn, Herbert. Jassidae of New York State. New York State Ent. Rept. 20: 513. 1904.

salicis (Linn.), *Chionaspis* (Willow scale) Fam. *Coccidae*
Synonyms—*Lecanium myrtilli* Kalt., *Lecanium vaccinii* Bouche.
Hosts—Acer, Alnus, Cornus, Fraxinus, Populus, Salix, Sorbus, Sarcothamnus, *Vaccinium myrtillus, V. uliginosum,* and *V. vitis-idaea.*
Injury—Sucks juices from plants.
Distribution—Europe.
References—Fernald, Mrs. Maria E. A catalogue of the Coccidae of the world, p. 223-225. 1903.
Silvestri, F. (correspondence under date of March 28, 1929).

septendecim (Linn.), *Magicicada (Tibicen)* Fam. *Cicadidae*
Hosts—Apple, dogwood, hickory, box huckleberry, lilac, linden, red oak, white oak, white cedar, wild cherry, *Vaccinium virgatum.*

Injury—Egg punctures in the wood.
Distribution—North America from the Atlantic Coast to the Rocky Mountains.
Reference—Girault, A. A. Fragments on North American Insects—IX Ent. news 26: 223. 1915.

solanifolii (Ashmead), *Macrosiphum* Fam. *Aphididae*
(see page 124)

ulmi (Linn.), *Lepidosaphes* (Oyster-shell scale) Fam. *Coccidae*
(see page 125)

vaccinii Mason, *Amphorophora* Fam. *Aphididae*
Hosts—*Vaccinium corymbosum, V. stamineum.*
Injury—Attacks terminals and foliage.
Distribution—Massachusetts, New Jersey, and Pennsylvania.
Reference—Mason, P. W. A revision of the insects of the aphid genus Amphorophora. Proc. U. S. Nat. Mus. 67, Art. 20, p. 67. 1925.

vaccinii (Van D.), *Euscelis* Fam. *Cicadellidae*
Hosts—Blueberry, sweet fern and allied plants.
Injury—Sucks sap from leaves and shoots.
Distribution—Quebec, Ontario, Maine, Massachusetts, Rhode Island, New York, New Jersey, and Pennsylvania.
Reference—De Long, D. M. Family Cicadellidae. *In* The Hemiptera of Connecticut. Connecticut State Geological and Nat. Hist. Surv. Bul. 34:122. 1923.

vaccinii Kuwana, *Fiorinia* Fam. *Coccidae*
Hosts—*Vaccinium bracteatum.*
Injury—Forms gall on lower surface of leaf.
Distribution—Europe.
Reference—Kuwana, I. Dept. Finance Japan Imp. Plant Quar. Serv. Tech. Bul. 3:1-20. 1925.

Myzus sp. Fam. *Aphididae*
(see page 124)

Pseudococcus sp. Fam. *Coccidae*
Hosts—Blueberry.
Injury—Forms scales on calyx end of berries.
Distribution—Maine.
Reference—Woods, W. C. Blueberry insects in Maine. Maine Agr. Expt. Sta. Bul. 244:285. 1915.

quercus Comst., *Eriococcus* Fam. *Coccidae*
Hosts—Gall-berry, grass, oak, and *Vaccinium corymbosum.*
Injury—Sucks juice from plants.
Distribution—Massachusetts to Florida, New Mexico, and Mexico.

References—Fernald, Mrs. Maria E. A catalogue of the Coccidae of the world, p. 78. 1903.
Packard, A. S. Forest insects. U. S. Ent. Comm. rept. 5:103. 1890.

websteri (King), *Eulecanium* Fam. *Coccidae*
Hosts—White birch, Carpinus, *Celtis occidentalis,* currant, mulberry, Ostrya, Spiraea, Vaccinium.
Injury—Sucks sap from leaves and stem.
Distribution—Canada, Nova Scotia, Massachusetts, Ohio, Iowa, and Kansas.
Reference—Fernald, Mrs. Maria E. A catalogue of the Coccidae of the world, p. 198. 1903.

THYSANOPTERA

vaccinii Morgan, *Frankliniella* Fam. *Thripidae*
(see page 125)
Aeolothrips sp. Fam. *Aeolothripidae*
(see page 125)

COLEOPTERA

asper Lec., *Auleutes* Fam. *Curculionidae*
Hosts—Huckleberry.
Injury—Beaten from huckleberry.
Distribution—Canada, Maine, Massachusetts, Connecticut, District of Columbia, Kansas, and Montana.
Reference—Blatchley, W. S. and Leng, C. W. Rhynchophora or weevils of north eastern America, p. 432. 1916.

cassandrae Lec., *Auletes* Fam. *Curculionidae*
Hosts—Huckleberry and red bay.
Injury—Feed on flowers.
Distribution—Gulf and South Atlantic States.
Reference—Blatchley, W. S. and Leng, C. W. Rhynchophora or weevils of north eastern America, p. 53. 1916.

castanea Arrow, *Aserica* Fam. *Scarabaeidae*
Hosts—Aster, bean, blueberry, burdock, butterfly bush, carrot, cherry, chrysanthemum. etc.
Injury—Beetles feed on foliage.
Distribution—Asia and, in North America, parts of Connecticut, Delaware, New York, New Jersey, Maryland, Pennsylvania, and District of Columbia.
Reference—Hallock, Harold C. Some observations upon the biology and control of *Aserica castanea* Arrow. Jour. econ. ent. 23:281-286. 1930.

concinna Lec., *Limnobaris* Fam. *Curculionidae*
Hosts—Huckleberry.
Injury—Attacks blossoms in the spring.
Distribution—New York, New Jersey, Florida, and Texas.
Reference—Blatchley, W. S. and Leng, C. W. Rhynchophora or weevils of north eastern America, p. 400. 1916.

corvulus Lec., *Anthonomus* Fam. *Curculionidae*
Hosts—Dogwood, Prunus, *Vaccinium stamineum,* Viburnum.
Injury—Feeds on flowers and develops in fruit.
Distribution—Nova Scotia and the United States from New England to Wisconsin and south to Florida, Texas, and Arizona.
Reference—Blatchley, W. S. and Leng, C. W. Rhynchophora or weevils of north eastern America, p. 298. 1916.

cryptops Dietz, *Hyperodes* Fam. *Curculionidae*
Hosts—Huckleberry and Saggitaria.
Injury—Feeds on flowers.
Distribution—Georgia and Florida.
Reference—Blatchley, W. S. and Leng, C. W. Rhynchophora or weevils of north eastern America, p. 167. 1916.

elusus Blatch., *Rhynchites* Fam. *Curculionidae*
Hosts—Huckleberry.
Injury—Feeds on flowers.
Distribution—Florida.
Reference—Blatchley, W. S. and Leng, C. W. Rhynchophora or weevils of north eastern America, p. 60. 1916.

formosus Melsh., *Bassareus* Fam. *Chrysomelidae*
(see page 129)

foxii Davis, *Phyllophaga* Fam. *Scarabaeidae*
Hosts—Blueberry, *Diospyros virginiana, Quercus falcata, Quercus rubra, Robinia hispida, Rosa* sp., *Rubus nigrobaccus.*
Injury—Adult beetles feed on leaves.
Distribution—Indiana.
Reference—Davis, J. J. New species and varieties of Phyllophaga. Illinois Nat. Hist. Surv. Bul. 13:329-338. 1920.

incipiens Dietz, *Pseudanthonomus* Fam. *Curculionidae*
Hosts—Laurel, *Vaccinium corymbosum.*
Injury—Feeds on flowers.
Distribution—Canada and New York to Michigan, and south to District of Columbia.
Reference—Blatchley, W. S. and Leng, C. W. Rhynchophora or weevils of north eastern America, p. 319. 1916.

japonica Newm., *Popillia* (Japanese beetle) Fam. *Scarabaeidae*
Hosts—Vaccinium corymbosum and many other trees and shrubs.

Injury—Feeds on leaves.
Distribution—Europe and eastern North America.
Reference—Driggers, B. F. Insects of the cultivated blueberry. *In* New Jersey Agr. Expt. Sta. Ent. rept. for 1926, p. 224. 1927.

musculus Say, *Anthonomus* (Cranberry weevil) Fam. *Curculionidae*
Hosts—*Aronia nigra, Gaylussacia resinosa, Vaccinium corymbosum.*
Injury—Beetles feed on blossoms in spring and later the new brood feed on the berries and more tender foliage.
Distribution—New England to the Rocky Mountains and Florida.
References—Franklin, Henry J. Cape Cod cranberry insects. Massachusetts Agr. Expt. Sta. Bul. 239:58-62. 1928.
Lacroix, D. S. The Life history and control of the cranberry weevil, *Anthonomus musculus* Say (Coleoptera, Curculionidae). Jour. econ. ent. 19:821. 1926.

myops Hald., *Oberea* Fam. *Cerambycidae*
Hosts—Apple, azalea, blackberry, cottonwood, dogwood, elm, mountain laurel, *Oxydendrum arboreum,* peach, plum, quince, and *Vaccinium corymbosum.*
Injury—Wilting of new shoots due to egg laying of beetles. Killing of canes due to larval tunnels in stems and roots.
Distribution—New Jersey.
Reference—Driggers, B. F. Notes on the life history and habits of the blueberry stem borer, *Oberea myops* Hald., on cultivated blueberries. Jour. New York Ent. Soc. 37: 67-74. 1929.

nitidula Fb., *Silis* Fam. *Lampyridae*
Hosts—*Vaccinium myrtillus.*
Injury—Feeds on the fruit.
Distribution—Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 414. 1874.

ovulum (Eusomus) (Polydrosus) Fam. *Curculionidae*
Hosts—*Vaccinium myrtillus.*
Injury—Adult beetles devour leaves.
Distribution—Europe.
Reference—Dufrenoy, J. Les charancons des myrtilles et des arbousiers. Contributions a l'etude du peuplement des ericacees. Rev. Zool. Agr. et Appl., Bordeaux, XX, no. 5, p. 38-39. 1921.

picipes Oliv., *Rhabdopterus* Fam. *Chrysomelidae*
Hosts—Apple, cranberry, wild grape, *Vaccinium corymbosum.*
Injury—Feeds on roots.
Distribution—Quebec, New York, New Jersey, and Indiana.

Reference—Driggers, B. F. Insects of the cultivated blueberry. *In* New Jersey Agr. Expt. Sta. Ent. rept. for 1926, p. 224. 1927.

plicata Fab., *Chlamys* Fam. *Chrysomelidae*
(see page 129)

profundus Lec., *Anthonomus* Fam. *Curculionidae*
Hosts—*Crataegus crus-galli,* huckleberry, oak.
Injury—Feeds on huckleberry blossoms, larva feeds in fruit.
Distribution—North America.
Reference—Blatchley, W. S. and Leng, C. W. Rhynchophora or weevils of north eastern America, p. 290. 1916.

punctatissimus Zimm., *Corthylus* Fam. *Scolytidae*
Hosts—Acer, Carpinus, Cornus, Corylus, Huckleberry, Ostrya, Sassafras, *Vaccinium corymbosum,* and *V. stamineum.*
Injury—Attacks roots making galleries in them.
Distribution—United States.
Reference—Blatchley, W. S. and Leng, C. W. Rhynchophora or weevils of north eastern America, p. 642. 1916.

retusus Marsh., *Strophosomus* Fam. *Curculionidae*
Hosts—*Arbutus unedo, Vaccinium myrtillus.*
Injury—Adults feed on leaves and terminal shoots.
Distribution—Europe.
Reference—Dufrenoy, J. Les charancons des myrtilles et des arbousiers. Contribution a l'etude du peuplement des ericacees. Rev. Zool. Agr. et Appl. Bordeaux, XX, no. 5, p. 38-39. 1921.

rotundatus Lec., *Anthribulus* Fam. *Anthribidae*
Hosts—Huckleberry.
Injury—Feeds on flowers.
Distribution—Massachusetts to Florida, southern New Jersey, Georgia, Louisiana, and Mexico.
Reference—Blatchley, W. S. and Leng, C. W. Rhynchophora or weevils of north eastern America, p. 41. 1916.

semirufus Lec., *Ceutorhynchus* Fam. *Curculionidae*
Hosts—*Vaccinium corymbosum.*
Injury—Feeds on flowers.
Distribution—Canada and New England westward to Michigan and Illinois.
Reference—Blatchley, W. S. and Leng, C. W. Rhynchophora or weevils of north eastern America, p. 451. 1916.

sexguttatus Dietz, *Anthonomus* Fam. *Curculionidae*
Hosts—Huckleberry.
Injury—Not stated.

Distribution—Florida.
Reference—Blatchley, W. S. and Leng, C. W. Rhynchophora or weevils of north eastern America, p. 303. 1916.

signatus Say, *Anthonomus* Fam. *Curculionidae*
Hosts—Blackberry, *Cercis canadensis,* strawberry, Vaccinium.
Injury—Destroys buds, feeds on pollen and tissues in blossoms and lays eggs in buds.
Distribution—Canada, New York and New England to Wisconsin, and south to Florida and Texas.
Reference—Blatchley, W. S. and Leng, C. W. Rhynchophora or weevils of north eastern America, p. 300. 1916.

torquata Lec., *Altica* Fam. *Chrysomelidae*
(see page 129)

turbulentum Smith, *Apion* Fam. *Curculionidae*
Hosts—*Cornus candidissima,* huckleberry.
Injury—Feeds on flowers.
Distribution—New York, Michigan, and south to Arkansas and Texas.
Reference—Blatchley, W. S. and Leng, C. W. Rhynchophora or weevils of north eastern America, p. 80. 1916.

vaccinii Fall, *Galerucella* Fam. *Chrysomelidae*
(see page 130)
validus Dietz, *Pseudanthonomus* Fam. *Curculionidae*
Hosts—Currant, *Vaccinium canadense, V. pennsylvanicum.*
Injury—Larvae develop in fruit.
Distribution—Canada, Maine, New York, Ohio, Nebraska, Colorado, and New Mexico.
Reference—Woods, W. C. Blueberry insects in Maine. Maine Agr. Expt. Sta. Bul. 244: 270. 1915.

varicorne Smith, *Apion* Fam. *Curculionidae*
Hosts—Huckleberry, *Parosela aurea.*
Injury—Larva develops in fruit.
Distribution—Georgia, Florida, Texas, and Oklahoma.
Reference—Blatchley, W. S. and Leng, C. W. Rhynchophora or weevils of north eastern America, p. 85. 1916.

venustus Fab., *Cryptocephalus* Fam. *Chrysomelidae*
(see page 132)
vespertina Gyll., *Serica* Fam. *Scarabaeidae*
(see page 128)

DIPTERA

altifila Felt, *Schizomyia (Asphondylia)* Fam. *Cecidomyiidae*
Hosts—Blueberry.
Injury—Not stated.

Distribution—New York.
Reference—Felt, E. P. A study of gall midges. IV. New York State Mus. Bul. 186:105. 1916.

melanogaster Meig., *Drosophila* Fam. *Drosophilidae*
Synonym—*Drosophila ampelophila* Loew.
Hosts—Apple, blueberry, grape, orange.
Injury—Larvae develop in fruit.
Distribution—North America and Europe.
Reference—Woods, W. C. Blueberry insects in Maine. Maine Agr. Expt. Sta. Bul. 244:270. 1915.

canadensis Felt, *Baldratia (Lasioptera)* Fam. *Cecidomyiidae*
Hosts—Blueberry.
Injury—Not stated.
Distribution—New York.
Reference—Felt, E. P. New species of Cecidomyiidae. II. New York State Mus. Bul. 124:322. 1908.

cyanococci Felt, *Dasyneura* Fam. *Cecidomyiidae*
Hosts—Blueberry, *Vaccinium canadense.*
Injury—Produces a loose, apical bud gall.
Distribution—Massachusetts.
Reference—Felt, E. P. New species of Cecidomyiidae. II. New York State Mus. Bul. 124:344. 1908.

cyanococci Felt, *Mycodiplosis* Fam. *Cecidomyiidae*
Hosts—Blueberry.
Injury—Taken on blueberry.
Distribution—New York.
Reference—Felt, E. P. New species of Cecidomyiidae. II. New York State Mus. Bul. 124:401. 1908.

fructuaria Felt, *Lasioptera* Fam. *Cecidomyiidae*
Hosts—Blueberry.
Injury—Midges reared from berries.
Distribution—Maine.
Reference—Woods, W. C. Blueberry insects in Maine. Maine Agr. Expt. Sta. Bul. 244:268-269. 1915.

fulva Felt, *Dasyneura* Fam. *Cecidomyiidae*
Hosts—Huckleberry.
Injury—Not stated.
Distribution—New York.
Reference—Leonard, M. D. A list of the insects of New York. Cornell Agr. Expt. Sta. Mem. 101:720. 1926.

gaylussacia Felt, *Cecidomyia (Dasyneura)* Fam. *Cecidomyiidae*
Hosts—Blueberry.
Injury—Produces leaf gall on midrib of leaf.

Distribution—New York.
Reference—Felt, E. P. Key to American insect galls. New York State Mus. Bul. 200:176. 1918.

lobata Felt, *Coquillettomyia* Fam. *Cecidomyiidae*
Synonym—*Mycodiplosis lobata* Felt.
Hosts—Blueberry.
Injury—Not stated.
Distribution—New York.
Reference—Leonard, M. D. A list of the insects of New York. Cornell Agr. Expt. Sta. Mem. 101:732. 1926.

obscura Felt, *Arthrocnodax* Fam. *Cecidomyiidae*
Hosts—Blueberry.
Injury—Not stated.
Distribution—New York.
Reference—Leonard, M. D. A list of the insects of New York. Cornell Agr. Expt. Sta. Mem. 101:735. 1926.

pomonella Walsh, *Rhagoletis* (The blueberry maggot) Fam. *Trypetidae*
(see page 132)

tabellaria Fitch, *Rhagoletis* Fam. *Trypetidae*
Hosts—Blueberry.
Injury—Destroys fruit.
Distribution—New York to Washington.
Reference—Plank, H. K. *Rhagoletis tabellaria* Fitch. Jour. econ. ent. 16:99. 1923.

vaccinii O.S., *Cecidomyia* Fam. *Cecidomyiidae*
Hosts—*Gaylussacia frondosa.*
Injury—Forms irregular globose or lobulate galls on leaves.
Distribution—New York.
Reference—Felt, E. P. Key to American insect galls. New York State Mus. Bul. 200:176. 1918.

vaccinii Kieff., *Clinodiplosis* Fam. *Cecidomyiidae*
Hosts—*Vaccinium uliginosum.*
Injury—Not stated.
Distribution—Europe.
Reference—Houard, C. Les Zoocecides des plantes d'Europe, 2:790. 1909.

vaccinii Felt, *Contarinia* (Blueberry tip worm) Fam. *Cecidomyiidae*
Hosts—Blueberry.
Injury—Dried and blackened leaf and fruit buds caused by the feeding of larvae in them.
Distribution—New Jersey.
Reference—Driggers, B. F. The blueberry tip worm (Contarinia vaccinii Felt), a new species of midge attacking cultivated blueberries. Jour. New York Ent. Soc. 34:82-85. 1926.

vaccinii McK., *Dasyneura (Perrisia)* Fam. *Cecidomyiidae*
Hosts—Cranberry, *Vaccinium myrtillus.*
Injury—Produces a leaf-fold or bud-gall.
Distribution—North America and Europe.
References—Houard, C. Les Zoocecides des plantes d'Europe, 2:294. 1909.
Franklin, H. J. Seventh report of the cranberry substation. Massachusetts Agr. Expt. Sta. Bul. 192:129. 1919.

LEPIDOPTERA

acraea Dru., *Estigmene* Fam. *Arctiidae*
(see page 179)

advena F., *Polia (Mamestra)* Fam. *Noctuidae*
Hosts—Bilberry (Heidelbeere).
Injury—Larvae eat buds and leaves.
Distribution—Northern and central Europe.
Reference—Spuler, A. Die Raupen der Schmetterlinge Europas, Tafel 24, fig. 17. 1904.

advenaria Hb., *Epione* Fam. *Geometridae*
Hosts—*Vaccinium myrtillus.*
Injury—Larvae feed on leaves and buds in June and July.
Distribution—Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.

albicomana Clem., *Argyrotoxa (Tortrix)* Fam. *Tortricidae*
Hosts—Huckleberry.
Injury—Larvae feed within rolled leaves.
Distribution—Atlantic States.
Reference—Smith, J. B. Insects of New Jersey, p. 550. 1909.

americana Fab., *Malacosoma (Clisiocampa)* Fam. *Lasiocampidae*
Hosts—Apple, blueberry, wild cherry, etc.
Injury—Larvae feed on leaves.
Distribution—Atlantic States.
Reference—Weed, Clarence M. The insect record for 1897. New Hampshire Agr. Expt. Sta. rept. 9:142. 1898.

angusi G. & R., *Datana* Fam. *Notodontidae*
Hosts—Hickory, huckleberry, etc.
Injury—Larvae feed on leaves.
Distribution—Atlantic States.
Reference—Smith, J. B. Insects of New Jersey, p. 486. 1909.

antiqua Linn., *Orgyia* Fam. *Lymantriidae*
Hosts—Blueberry and conifers.
Injury—Defoliators in vast numbers.
Distribution—North America and Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 415. 1874.

apiata Grt., *Epiglaea* Fam. *Noctuidae*
Hosts—Blueberry, cranberry.
Injury—Larvae feed on leaves.
Distribution—Northeastern states from Maine to Illinois.
Reference—Franklin, H. J. Cape Cod cranberry insects. Massachusetts Agr. Expt. Sta. Bul. 239:26. 1928.

archippus Cram., *Basilarchia (Limenitis)* Fam. *Nymphalidae*
Hosts—Huckleberry, oak, plum, poplar, willow.
Injury—Larvae feed on leaves.
Distribution—North America.
Reference—Smith, J. B. Insects of New Jersey, p. 412. 1909.

astricta Morr., *Lycophotia* Fam. *Noctuidae*
(see page 163)

astyanax Fab., *Basilarchia* Fam. *Nymphalidae*
Hosts—Huckleberry, wild cherry.
Injury—Larvae feed on leaves.
Distribution—Atlantic States and Arizona.
References—Leonard, M. D. A list of the insects of New York. Cornell Univ. Mem. 101:686. 1926.
Smith, J. B. Insects of New Jersey, p. 12. 1909.

astylus Dru., *Paonias* Fam. *Sphingidae*
Hosts—Blueberry, dangleberry, and huckleberry.
Injury—Larvae feed on leaves.
Distribution—Atlantic States.
References—Fernald, C. H. Sphingidae of New England, p. 77. 1886.
Smith, J. B. Insects of New Jersey, p. 430. 1909.

auricinctaria Grt., *Melanomma* Fam. *Noctuidae*
Hosts—Cephalanthus and huckleberry.
Injury—Larvae feed on leaves.
Distribution—Atlantic States.
Reference—Leonard, M. D. A list of the insects of New York. Cornell Univ. Mem. 101:620. 1926.

auricoma F., *Acronycta* Fam. *Noctuidae*
Hosts—Birch, oak, poplar, Rubus, *Vaccinium myrtillus, V. vitis-idaea,* and willow.
Injury—Larvae feed on buds and leaves in June and July and again in September and October.

Distribution—Northern and central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 415. 1874.

bicarnea Gn., *Agrotis* Fam. *Noctuidae*
(see page 151)

bidentata Clem., *Gonodontis (Odontoptera)* Fam. *Geometridae*
Hosts—Ash, blueberry, heath-broom, oak, plum, privet.
Injury—Larvae destroy foliage.
Distribution—Northern and central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.

bipunctana F., *Olethreutes (Sericoris)* Fam. *Tortricidae*
Hosts—Blueberry.
Injury—Larvae feed within spun leaves in May.
Distribution—Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 418. 1874.

brunneata Thun., *Itame (Cymatophora)* Fam. *Geometridae*
Synonyms—*Macaria pracatomata, Thamnonoma brunneata* Thnbg.
Hosts—Blueberry.
Injury—Larvae feed on leaves in July.
Distribution—North America and Europe.
References—Leonard, M. D. A list of the insects of New York. Cornell Univ. Mem. 101:600. 1926.
Spuler, A. Die Raupen der Schmetterlinge Europas, Tafel 44, fig. 7a. 1904.

brunneicollis Grt., *Lampra* Fam. *Noctuidae*
(see page 167)

burgessiella Zell., *Gracilaria* Fam. *Gracilariidae*
Hosts—Cornus, huckleberry.
Injury—Larvae feed on leaves.
Distribution—Atlantic States.
References—Leonard, M. D. A list of the insects of New York. Cornell Univ. Mem. 101:541. 1926.
Smith, J. B. Insects of New Jersey, p. 572. 1909.

c-nigrum Linn., *Agrotis* Fam. *Noctuidae*
(see page 152)

caesiata Lang., *Larentia (Glaucopteryx)* Fam. *Geometridae*
Hosts—*Vaccinium myrtillus, V. vitis-idaea,* whortleberry.
Injury—Larvae feed on leaves.
Distribution—Europe including Great Britain; North America.

References—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.
Packard, A. S. A monograph of the geometrid moths of the United States, p. 67. 1876.

canadensis Boisduval, *Sphinx* Fam. *Sphingidae*
Hosts—Low blueberry, *Rubus chamaemorus.*
Injury—Larvae feed on leaves.
Distribution—Newfoundland and Maine.
Reference—Fernald, C. H. The Sphingidae of New England, p. 43. 1886.

castanea Esp., *Agrotis* Fam. *Noctuidae*
Hosts—Ginster, heath, sorrel, *Vaccinium myrtillus.*
Injury—Larvae feed on leaves.
Distribution—England, Germany, and Scandinavia.
References—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.
Spuler, A. Die Raupen der Schmetterlinge Europas, Tafel 22, fig. 25. 1904.

catenaria Dru., *Cingilia* Fam. *Geometridae*
(see page 138)

cecropia Linn., *Samia* Fam. *Saturniidae*
Hosts—Many trees and shrubs including blueberry.
Injury—Larvae feed on leaves.
Distribution—North America east of Rocky Mountains.
References—Leonard, M. D. A list of the insects of New York. Cornell Univ. Mem. 101:587. 1926.
Packard, A. S. Fifth rept. U. S. Ent. Comm., p. 402. 1890.

chi Linn., *Polia* Fam. *Noctuidae*
Hosts—*Vaccinium myrtillus.*
Injury—Larvae feed on leaves.
Distribution—Northern and central Europe.
Reference—Schoyen, T. H. (letter of March 19, 1929).

cinctitia Grt., *Calocampa* Fam. *Noctuidae*
(see page 174)

cinnamomeana Tr., *Pandemis (Tortrix)* Fam. *Tortricidae*
Hosts—Birch, blueberry, cherry, mountain ash.
Injury—Larvae spin leaves together and feed on them.
Distribution—Central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.

clandestina Harr., *Noctua* Fam. *Noctuidae*
(see page 162)

cognataria Gn., *Amphidasis* Fam. *Geometridae*
(see page 146)

cognataria Hbn., *Glena* Fam. *Geometridae*
(see page 146)

concinna A. & S., *Schizura (Oedemasia)* Fam. *Notodontidae*
Hosts—Gaylussacia (huckleberry), Crataegus, Malus.
Injury—Larvae feed on leaves, often in a colony.
Distribution—North America.
References—Packard, A. S. Fifth rept. U. S. Ent. Comm., p. 457. 1890.
Slingerland, M. V., and Crosby, C. R. Manual of fruit insects, p. 125. 1914.

confusalis H.S., *Nola* Fam. *Nolidae*
Hosts—Blueberry.
Injury—Larvae feed on leaves in July.
Distribution—Europe including Great Britain; Japan.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.

contigua Vill., *Polia (Mamestra)* Fam. *Noctuidae*
Hosts—Barberry, blackberry, *Chenopodium bonus, Genista* sp., huckleberry, Solidago, *Vaccinium myrtillus,* etc.
Injury—Larvae are defoliators.
Distribution—Europe and Asia.
References—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 415. 1874.
Spuler, A. Die Raupen der Schmetterlinge Europas, Tafel 24, fig. 20. 1904.

cordigera Thnbg., *Anarta* Fam. *Noctuidae*
Hosts—Arbutus and *Vaccinium uliginosum.*
Injury—Larvae feed on leaves.
Distribution—Northern and central Europe.
References—Felt, E. P. Insects affecting park and woodland trees. New York State Mus. Mem. 8, vol. 2:738. 1906.
Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.

debiliata Hb., *Chloroclystis (Eupithecia)* Fam. *Geometridae*
Hosts—Vaccinium myrtillus.
Injury—Larvae spin leaves together and feed inside.
Distribution—Central Europe.
References—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.
Spuler, A. Die Raupen der Schmetterlinge Europas, Tafel 47, fig. 7. 1904.

decoralis Hb., *Pangrapta* Fam. *Noctuidae*
(see page 178)

derasana Hb., *Ancylis (Grapholitha)* Fam. *Tortricidae*
Hosts—Blueberry, pea, privet.
Injury—Larvae feed on foliage.
Distribution—Central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 418. 1874.

detracta Wlk., *Polia (Miselia)* Fam. *Noctuidae*
(see page 169)

didymata Linn., *Larentia (Cidaria)* Fam. *Geometridae*
Hosts—Blueberry and *Orobus tuberosus.*
Injury—Larvae feed on leaves in May and June.
Distribution—Northern and central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.

dispar Linn., *Porthetria* Fam. *Lymantriidae*
Hosts—Cranberry, Crataegus, high and low blueberry and many other trees and shrubs.
Injury—Larvae feed on leaves, often in vast numbers.
Distribution—Europe, Asia, New England States.
References—Mosher, F. H. Food plants of the gipsy moth in America. U. S. Dept. Agr. Bul. 250. 1915.
Spuler, A. Schmetterlinge Europas, 1:131. 1908.

disstria Hbn., *Malacosoma* Fam. *Lasiocampidae*
(see page 138)

distans Grt., *Acronycta* Fam. *Noctuidae*
(see page 175)

diversella Braun, *Lithocolletis* Fam. *Gracilariidae*
Hosts—Gaylussacia baccata, Oxydendrum arboreum.
Injury—Larvae produce mines on underside of leaves.
Distribution—Ohio and Kentucky.
References—Forbes, W. T. M. Lepidoptera of New York and neighboring states. Cornell Agr. Expt. Sta. Mem. 68:193. 1923.
Braun, Annette F. Notes on Lithocolletis with descriptions of new species (Lep.), Ent. news 27:82-84. 1916.

dotata Linn., *Larentia* Fam. *Geometridae*
Synonym—Cidaria populata S.V.
Hosts—Blueberry, Epilobium, poplar, willow.
Injury—Larvae feed on leaves in May and June.
Distribution—Europe.

Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten. p. 416. 1874.

drexeli Hy. Edw., *Datana* Fam. *Notodontidae*
Hosts—Huckleberry, witch hazel.
Injury—Larvae feed on leaves.
Distribution—Atlantic States.
References—Leonard, M. D. A list of the insects of New York. Cornell Agr. Expt. Sta. Mem. 101: 614. 1926.
Smith, J. B. Insects of New Jersey, p. 486. 1909.

ducens Wlk., *Feltia* Fam. *Noctuidae*
(see page 150)

cnnucleata Gn., *Acidalia (Synelys)* Fam. *Geometridae*
Synonym—*Synelys restrictata* Wlk.
Hosts—Huckleberry, wild cherry.
Injury—Larvae feed on leaves.
Distribution—Atlantic States and the Rocky Mountains.
Reference—Smith, J. B. Insects of New Jersey, p. 498. 1909.

euphorbiae var. *montivaga* Gn., *Acronycta* Fam. *Noctuidae*
Hosts—Birch, Crataegus, Euphorbia, Gentiana, Rubus, Rumex, *Vaccinium myrtillus, V. uliginosum, V. vitis-idaea.*
Injury—Larvae feed on leaves.
Distribution—Asia Minor and Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 415. 1874.

fasciola H. S., *Lithacodes* Fam. *Limacodidae*
Hosts—Basswood, huckleberry.
Injury—Larvae feed on leaves.
Distribution—Atlantic States.
Reference—Smith, J. B. Insects of New Jersey, p. 513. 1909.

fennica Tausch., *Agrotis* Fam. *Noctuidae*
(see page 154)

filipendulae Linn., *Zygaena* Fam. *Zygaenidae*
Hosts—*Vaccinium myrtillus.*
Injury—Larvae feed on leaves.
Distribution—Europe.
Reference—Schoyen, T. H. (letter of March 19, 1929).

flammealis Schiff., *Endotricha* Fam. *Pyralididae*
Hosts—Blueberry.
Injury—Larvae feed on leaves.
Distribution—Northern and central Europe.
Reference—Spuler, A. Die Raupen der Schmetterlinge Europas. Tafel 9, fig. 48 (Nachtrag) 1904.

fontis Thnbg., *Bomolocha* Fam. *Noctuidae*
Hosts—Blueberry.
Injury—Larvae feed on leaves.
Distribution—Northern and central Europe.
Reference—Spuler, A. Die Raupen der Schmetterlinge Europas, Tafel 38, fig. 18a. 1904.

forsterana Hb., *Tortrix* Fam. *Tortricidae*
Synonym—Tortrix adjunctana Tr.
Hosts—Ledum palustre, Pinus picea, Vaccinium uliginosum.
Injury—Larvae feed in May between spun leaves.
Distribution—Northern and central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 418. 1874.

fulvago Linn., *Xanthia* Fam. *Tortricidae*
Hosts—Vaccinium myrtillus.
Injury—Larvae feed on leaves.
Distribution—Northern and central Europe.
Reference—Schoyen, T. H. (letter of March 19, 1929).

fumata Stph., *Acidalia* Fam. *Geometridae*
Synonym—Acidalia commutata Frr.
Hosts—Lactuca sativa, Lonicera periclymenum, Vaccinium myrtillus.
Injury—Larvae feed on foliage in spring and fall.
Distribution—Northern Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.

gaylussaciana Kearf., *Cymolomia* Fam. *Tortricidae*
Hosts—Huckleberry.
Injury—Larvae feed on leaves.
Distribution—New Jersey.
Reference—Smith, J. B. Insects of New Jersey, p. 538. 1909.

gaylussaciella Hein., *Coleophora* Fam. *Coleophoridae*
Hosts—Gaylussacia baccata.
Injury—Larvae feed on leaves.
Distribution—Virginia.
Reference—Forbes, W. T. M. The Lepidoptera of New York and neighboring states. Cornell Agr. Expt. Sta. Mem. 68:212. 1923.

genistae Bkh., *Polia (Mamestra)* Fam. *Noctuidae*
Hosts—Genista, *Spartium scoparium, Thalictrum minus, Vaccinium myrtillus.*
Injury—Larvae feed only at night on leaves and buds.
Distribution—Northern and central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 415. 1874.

georgiella Wlk., *Dichomeris (Tortrix)* Fam. *Gelechiidae*
Hosts—*Vaccinium corymbosum,* oak.
Injury—Larvae feed on rolled leaves and skeletonize them.
Distribution—General in North America.
Reference—Weiss, Harry B. Additions to insects of New Jersey, No. 5. Ent. news 28:219. 1917.

gerningana Schiff., *Amphisa (Tortrix)* Fam. *Tortricidae*
Hosts—Plantain, *Vaccinium uliginosum.*
Injury—Larvae feed on leaves and roll them.
Distribution—Europe and Asia Minor.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.

gimmerthaliana Z., *Steganoptycha (Grapholitha)* Fam. *Tortricidae*
Hosts—*Vaccinium uliginosum.*
Injury—Larvae feed on leaves.
Distribution—Western Russia and Sweden.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 418. 1874.

glauca Hb., *Polia (Hadena)* Fam. *Noctuidae*
Hosts—*Arnica montana,* blueberry, Hieracium blossoms.
Injury—Larvae eat foliage and flowers—2 generations.
Distribution—Northern and central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 415. 1874.

glaucus turnus Linn., *Papilio* Fam. *Papilionidae*
(see page 179)

gonostigma F., *Orgyia* Fam. *Lymantriidae*
Hosts—Alder, apricot, heath, heidelbeere (blueberry), oak, rose, rose-mallow, wild plum.
Injury—Larvae feed on leaves in June and July.
Distribution—Europe and Asia.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 415. 1874.

gordius Stoll., *Sphinx* Fam. *Sphingidae*
Hosts—Apple, bayberry, cranberry, huckleberry, sweet fern.
Injury—Larvae are defoliators.
Distribution—Atlantic States to the Mississippi Valley.
References—Felt, E. P. Insects affecting park and woodland trees. New York State Mus. Mem. 8, vol. 2: 727. 1906.
Smith, J. B. Insects of New Jersey, p. 429. 1909.
Franklin, H. J. Cape Cod cranberry insects. Massachusetts Agr. Expt. Sta. Bul. 239:5. 1928.

graphica atlantica B. and McD., *Drasteria* Fam. *Noctuidae*
(see page 176)

hastata var. *gothicata* Gn., *Eulype* Fam. *Geometridae*
Hosts—Birch, blueberry, huckleberry, willow.
Injury—Larvae feed on leaves.
Distribution—Northern United States and Europe.
Reference—Smith, J. B. Insects of New Jersey, p. 497. 1909.

hastiana Linn., *Peronea (Acalla)* Fam. *Tortricidae*
Synonym—*Teras sparsana* Hb.
Hosts—Andromeda, Salix, *Vaccinium uliginosum.*
Injury—Larvae feed on leaves.
Distribution—Europe and Atlantic States.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 418. 1874.

helvolva Linn., *Orthosia* Fam. *Noctuidae*
Synonym—*Xanthia rufina* Linn.
Hosts—Blueberry, *Erica vulgaris.*
Injury—Larvae defoliate plants.
Distribution—Northern and central Europe.
References—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 415. 1874.
Spuler, A. Die Raupen der Schmetterlinge Europas, Tafel 31, fig. 19. 1904.

hircina Morr., *Homoglaea* Fam. *Noctuidae*
Hosts—Huckleberry and other plants.
Injury—Larvae feed on leaves.
Distribution—Atlantic States.
Reference—Smith, J. B. Insects of New Jersey, p. 466. 1909.

hortuellus Hb., *Crambus* Fam. *Pyralididae*
Hosts—Blueberry, cranberry, and other low plants.
Injury—Larvae feed on roots.
Distribution—North America and Europe.
Reference—Franklin, H. J. Eighth rept. of the cranberry substation. Massachusetts Agr. Expt. Sta. Bul. 206:159-160. 1921.

humerosana Clem., *Amorbia* Fam. *Tortricidae*
Hosts—Huckleberry and other plants.
Injury—Larvae roll leaves and feed within.
Distribution—Atlantic States.
References—Frost, S. W. The dusky leaf-roller. Pennsylvania Agr. Expt. Sta. Bul. 205. 1916.
Smith, J. B. Insects of New Jersey, p. 550. 1909.

hylaeus Dru., *Dolba* Fam. *Sphingidae*
(see page 138)

hyperborea Zett., *Agrotis* Fam. *Noctuidae*
Hosts—Vaccinium myrtillus
Injury—Larvae feed on foliage.
Distribution—Europe.
Reference—Spuler, A. Die Raupen der Schmetterlinge Europas, Tafel 2, fig. 21. (Nachtrag) 1904.

ilicifolia Linn., *Epicnaptera (Gastropacha)* Fam. *Lasiocampidae*
Hosts—Blueberry, willow.
Injury—Larvae feed in June and August on leaves.
Distribution—Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 415. 1874.

inceptaria Wlk., *Itame (Diastictis)* Fam. *Geometridae*
Hosts—Vaccinium pennsylvanicum.
Injury—Larvae defoliate bushes and eat blossoms.
Distribution—Canada and Atlantic States.
Reference—Slingerland, M. V. The blueberry spanworm....Canad. ent. 29:49-52. 1897. illus.

incertata Wlk., *Mesothea* Fam. *Geometridae*
(see page 147)

incursata Hb., *Xanthorhoe (Larentia)* Fam. *Geometridae*
Hosts—Vaccinium myrtillus, V. uliginosum.
Injury—Larvae feed on leaves.
Distribution—Europe and northern United States.
Reference—Spuler, A. Die Raupen der Schmetterlinge Europas, Tafel 7, fig. 15. (Nachtrag) 1904.

identanus Dyar, *Strepsicrates (Phthinolophus)* Fam. *Eucosmidae*
Hosts—Huckleberry.
Injury—Larvae web huckleberry leaves together and feed on them.
Distribution—Atlantic States and Canada.
References—Forbes, W. T. M. The Lepidoptera of New York and neighboring states. Cornell Agr. Expt. Sta. Mem. 68:436. 1923.
Smith, J. B. Insects of New Jersey, p. 547. 1909.

infernalis H. S., *Gelechia* Fam. *Gelechiidae*
Hosts—Blueberry.
Injury—Larvae feed on buds and leaves in April and May.
Distribution—Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 418. 1874.

interrogationis Linn., *Plusia* Fam. *Noctuidae*
Hosts—Vaccinium uliginosum.
Injury—Larvae feed on leaves.

Distribution—Northern and central Europe.
Reference—Spuler, A. Die Raupen der Schmetterlinge Europas, Tafel 4, fig. 25. (Nachtrag) 1904.

interruptolineana Fern., *Olethreutes (Argyroploce)* Fam. *Eucosmidae*
Hosts—Huckleberry, *Vaccinium* sp.
Injury—Larvae bind leaves and feed on them.
Distribution—New Hampshire to District of Columbia.
References—Forbes, W. T. M. The Lepidoptera of New York and neighboring states. Cornell Agr. Expt. Sta. Mem. 68:457. 1923.
Smith, J. B. Insects of New Jersey, p. 540. 1909.

ipomoeae Dbldy., *Schizura* Fam. *Notodontidae*
Hosts—Blackberry, huckleberry, etc.
Injury—Larvae eat leaves.
Distribution—North America.
Reference—Smith, J. B. Insects of New Jersey, p. 489. 1909.

irus Gdt., *Incisalia (Thecla)* Fam. *Lycaenidae*
Hosts—Bilberry, huckleberry, wild plum.
Injury—Larvae feed on leaves.
Distribution—United States.
References—Forbes, S. A. Noxious and beneficial insects of the state of Illinois. Illinois State Ent. rept. 14:74. 1885.
Smith, J. B. Insects of New Jersey, p. 415. 1909.

lactearia Linn., *Thalera* Fam. *Geometridae*
Hosts—Blueberry.
Injury—Larvae feed on leaves.
Distribution—Europe.
Reference—Spuler, A. Die Raupen der Schmetterlinge Europas, Tafel 39, fig. 11. 1904.

lambda F., *Xylina* Fam. *Noctuidae*
Hosts—Blueberry.
Injury—Larvae feed on leaves.
Distribution—Europe including Great Britain.
Reference—Spuler, A. Die Raupen der Schmetterlinge Europas, Tafel 32, fig. 16. 1904.

latifasciella Cham., *Telphusa* Fam. *Gelechiidae*
Hosts—Blueberry, huckleberry, oak.
Injury—Larvae roll leaves and feed on them.
Distribution—Massachusetts to North Carolina and Missouri.
References—Doaks, K. D. Records of blueberry insects. Indiana Acad. Sci. Proc. 43:441-444. 1927.
Smith, J. B. Insects of New Jersey, p. 555. 1909.

leucographa Hb., *Pachnobia* Fam. *Noctuidae*
Hosts—Blueberry.
Injury—Larvae feed on leaves.
Distribution—Northern and central Europe.
Reference—Spuler, A. Die Raupen der Schmetterlinge Europas, Tafel 3, fig. 2. (Nachtrag) 1904.

lineata Sc., *Scoria* Fam. *Geometridae*
Hosts—*Vaccinium myrtillus.*
Injury—Larvae feed on foliage.
Distribution—Central Europe.
Reference—Schoyen, T. H. (letter of March 19, 1929).

liparops strigosa Harr., *Strymon* Fam. *Lycaenidae*
Hosts—Chokeberry *(Pyrus melanocarpa), Vaccinium corymbosum.*
Injury—Larvae feed on leaves.
Distribution—Atlantic States.
Reference—Leonard, M. D. A list of the insects of New York. Cornell Agr. Expt. Sta. Mem. 101:679. 1926.

litura Linn., *Orthosia* Fam. *Noctuidae*
Hosts—Artemisia, birch, blueberry, wild plum, wild rose, willow.
Injury—Larvae feed on foliage.
Distribution—Northern and central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 415. 1874.

lorea, Gn.. *Polia* Fam. *Noctuidae*
(see page 170)

lubens Grt., *Polia* Fam. *Noctuidae*
Hosts—Birch, huckleberry, sumac.
Injury—Larvae feed in June and early August on leaves.
Distribution—Northern United States.
Reference—Leonard, M. D. A list of the insects of New York. Cornell Agr. Expt. Sta. Mem. 101:657. 1926.

maccana Tr., *Peronea (Teras)* Fam. *Tortricidae*
Hosts—Blueberry, Ledum.
Injury—Larvae feed on leaves.
Distribution—Massachusetts and Europe including Great Britain.
References—Forbes, W. T. M. The Lepidoptera of New York and neighboring states. Cornell Agr. Expt. Sta. Mem. 68:486. 1923.
Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 418. 1874.

magnella Braun, *Coptodisca* Fam. *Heliozelidae*
Hosts—Gaylussacia.
Injury—Larvae feed on leaves.

Distribution—Ohio.
Reference—Forbes, W. T. M. The Lepidoptera of New York and neighboring states. Cornell Agr. Expt. Sta. Mem. 68:228. 1923.

margaritosa Haw., *Lycophotia* Fam. *Noctuidae*
(see page 165)

melanaria Linn., *Arichanna (Zerene)* Fam. *Geometridae*
Hosts—*Vaccinium uliginosum.*
Injury—Larvae feed on foliage in May.
Distribution—Europe.
References—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.
Spuler, A. Die Raupen der Schmetterlinge Europas, Tafel 40, fig. 16a. 1904.

menyanthidis View., *Acronycta* Fam. *Noctuidae*
Hosts—Blueberry and cranberry.
Injury—Larvae feed on leaves.
Distribution—Northern and central Europe.
Reference—Spuler, A. Die Raupen der Schmetterlinge Europas, Tafel 21, fig. 29. 1904.

minimalis Grt., *Lampra* Fam. *Noctuidae*
(see page 168)

minuta Rob., *Peronea* Fam. *Tortricidae*
Hosts—Apple, cranberry, huckleberry, *Vaccinium corymbosum.*
Injury—Larvae web leaves into a nest and eat leaves and berries.
Distribution—Eastern North America.
Reference—Smith J. B. Insects injurious in cranberry culture. U. S. Dept. Agr. Farmers' Bul. 178:12. 1903.

monacha Linn., *Lymantria (Liparis)* Fam. *Lymantriidae*
Hosts—Apple, beech, birch, larch, oak, pine, plum, *Vaccinium myrtillus,* and willow.
Injury—Larvae feed on pine needles and leaves of other plants.
Distribution—Northern and central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.

myrtaria Gn., *Cosymbia* Fam. *Geometridae*
Hosts—Huckleberry, sweet fern.
Injury—Larvae feed on leaves.
Distribution—Atlantic States and Colorado.
Reference—Smith, J. B. Insects of New Jersey, p. 498. 1909.

myrtillana Tr., *Ancylis (Phoxopteryx)* Fam. *Tortricidae*
Hosts—*Vaccinium myrtillus.*

Injury—Larvae feed on leaves.
Distribution—Northern and central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 418. 1874.

myrtillella Stt., *Nepticula* Fam. *Nepticulidae*
Hosts—Vaccinium myrtillus, V. uliginosum.
Injury—Larvae feed in folded leaves in July and again in September.
Distribution—Europe including Great Britain.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 420. 1874.

myrtilli Linn., *Anarta* Fam. *Noctuidae*
Hosts—Erica tetralis, E. vulgaris, Vaccinium myrtillus, V. uliginosum.
Injury—Larvae feed on leaves in July and again in September.
Distribution—Northern and central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.

naevana Hb., *Rhopobota* Fam. *Tortricidae*
Hosts—Cranberry, Crataegus, Ilex, Malus, Rhamnus, Sorbus, *Vaccinium myrtillus, V. uliginosum.*
Injury—Larvae tie leaves of new shoots together in May.
Distribution—United States and northern and central Europe.
References—Forbes, W. T. M. The Lepidoptera of New York and neighboring states. Cornell Agr. Expt. Sta. Mem. 68:411. 1923.
Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 418. 1874.

nebulifera Stph., *Prionapteryx* Fam. *Pyralididae*
Hosts—Huckleberry and other heath plants.
Injury—Larvae feed on leaves.
Distribution—New York to Massachusetts and south along the Coast to Texas.
References—Forbes, W. T. M. The Lepidoptera of New York and neighboring states. Cornell Agr. Expt. Sta. Mem. 68:588. 1923.
Smith, J. B. Insects of New Jersey, p. 528. 1909.

nitidulana Z., *Steganoptycha (Phoxopteryx)* Fam. *Tortricidae*
Hosts—Vaccinium uliginosum.
Injury—Larvae feed on leaves in June.
Distribution—Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 418. 1874.

normaniana Grt., *Agrotis* Fam. *Noctuidae*
(see page 158)

obesalis Tr., *Hypena* Fam. *Noctuidae*
Synonym—Hypena crassalis F.
Hosts—Heidekraut, *Urtica ureus, Vaccinium myrtillus.*
Injury—Larvae feed on foliage.
Distribution—Central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.

obfirmaria Hb., *Metarranthis (Gonodontis)* Fam. *Geometridae*
Hosts—Blueberry, Cassandra.
Injury—Larvae feed on leaves.
Distribution—Atlantic States.
Reference—Forbes, W. T. M. Field tables of Lepidoptera, p. 102. 1906.

oblata Morr., *Agrotis* Fam. *Noctuidae*
(see page 159)

oblongata Thnbg., *Tephroclystia (Eupithecia)* Fam. *Geometridae*
Hosts—Vaccinium myrtillus.
Injury—Larvae feed on leaves.
Distribution—Europe.
Reference—Schoyen, T. H. (letter of March 19, 1929).

occulta Linn., *Lycophotia* Fam. *Noctuidae*
(see page 166)

oehlmanniella Tr., *Incurvaria* Fam. *Tineidae*
Hosts—Vaccinium myrtillus.
Injury—Larvae dwell in sack made of folded leaves.
Distribution—Central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 420. 1874.

opima Grt., *Dryotype (Taeniocampa)* Fam. *Noctuidae*
Hosts—Rumex, Vaccinium.
Injury—Larvae feed on leaves and buds.
Distribution—Europe.
Reference—Rangnow, H. Beiträge zur Biologie einiger Noctuiden und über vermeintliche oder wirkliche Schadlichkeit ihrer Raupen. Zeitschrift f. wiss. insektenbiologie 20:62. 1925.

optilete Kn., *Lycaena* Fam. *Lycaenidae*
Hosts—Vaccinium myrtillus, V. oxycoccus.
Injury—Larvae feed on foliage and flowers in May and June and again in the fall.
Distribution—Europe.
References—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 415. 1874.
Schoyen, T. H. (letter of March 19, 1929).

orbitella Z., *Coleophora* Fam. *Elachistidae*
Hosts—*Vaccinium myrtillus.*
Injury—Larvae feed on leaves.
Distribution—Central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 418. 1874.

palaeno Linn., *Philodice (Colias)* Fam. *Pieridae*
Hosts—*Vaccinium uliginosum.*
Injury—Larvae feed on leaves and buds.
Distribution—Scandinavia and Russia.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 415. 1874.

palmi Beut., *Datana* Fam. *Notodontidae*
Hosts—Huckleberry, *Vaccinium stamineum.*
Injury—Larvae feed on leaves.
Distribution—Atlantic States.
Reference—Smith, J. B. Insects of New Jersey, p. 486. 1909.

pavonia Linn., *Saturnia* Fam. *Saturniidae*
Synonym—*Saturnia carpini* Hb.
Hosts—Alder, bilberry, birch, blueberry, heath, oak, strawberry, etc.
Injury—Larvae feed on leaves in June and July.
Distribution—Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 415. 1874.

perattenta Grt., *Eueretagrotis* Fam. *Noctuidae*
(see page 168)

permundana Clem., *Cymolomia (Exartema)* Fam. *Tortricidae*
Hosts—Huckleberry, Opulaster, raspberry.
Injury—Larvae feed on leaves.
Distribution—Atlantic States.
Reference—Forbes, W. T. M. The Lepidoptera of New York and neighboring states. Cornell Agr. Expt. Sta. Mem. 68:466. 1923.

phyllophora Grt., *Agrotis* Fam. *Noctuidae*
(see page 160)

picta Harr., *Ceramica* Fam. *Noctuidae*
(see page 173)

pilullella Hb., *Nemophora* Fam. *Tineidae*
Hosts—Blueberry.
Injury—Larvae make cases out of the leaves.
Distribution—Northern and central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 420. 1874.

podana Sc., *Cacoecia* Fam. *Tortricidae*
Synonym—Tortrix ameriana Hb.
Hosts—Alder, aspen, birch, bird-cherry, blueberry, elm, hazel, mountain ash, oak, rose, wild plum, willow.
Injury—Larvae feed on leaves.
Distribution—Central Europe and Asia Minor.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.

politana Hw., *Eulia (Tortrix)* Fam. *Tortricidae*
Hosts—Centauria jacea, Erica vulgaris, Potentilla, Ranunculus, *Vaccinium myrtillus.*
Injury—Larvae feed on leaves in July and again in September.
Distribution—Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 418. 1874.

polyphemus Cram., *Telea* Fam. *Saturniidae*
Hosts—Betula, Crataegus, Hicoria, Juglans, Quercus, Rosa, Ulmus, Vaccinium, and others.
Injury—Larvae feed on leaves.
Distribution—North America.
References—Forbes, S. A. Noxious and beneficial insects of the state of Illinois. Illinois ent. rept. 14:71. 1885.
Packard, A. S. Forest insects. Fifth rept. U. S. Ent. Comm., p. 401, 1890.

populata Linn., *Lygris* Fam. *Geometridae*
Hosts—Blueberry.
Injury—Larvae feed on leaves.
Distribution—Northern and central Europe.
Reference—Spuler, A. Die Raupen der Schmetterlinge Europas, Tafel 45, fig. 13. 1904.

preciosella Dietz, *Parornix (Ornix)* Fam. *Gracilariidae*
Hosts—Vaccinium corymbosum.
Injury—Larvae feed on leaves in autumn.
Distribution—Connecticut, New Jersey, and Pennsylvania.
References—Forbes, W. T. M. The Lepidoptera of New York and neighboring states. Cornell Agr. Expt. Sta. Mem. 68:167. 1923.
Smith, J. B. Insects of New Jersey, p. 572. 1909.

pruinosella Z., *Epithectis (Gelechia)* Fam. *Gelechiidae*
Hosts—Andromeda polifolia, Vaccinium myrtillus, V. uliginosum.
Injury—Larvae feed on leaves in spring and fall.
Distribution—Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 418. 1874.

prunaria Linn., *Angerona* Fam. *Geometridae*
Hosts—Blueberry.
Injury—Larvae feed on leaves.
Distribution—Northern and central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.

pulchrina Hw., *Plusia* Fam. *Noctuidae*
Hosts—Blueberry.
Injury—Larvae feed on foliage.
Distribution—Northern and central Europe.
Reference—Spuler, A. Die Raupen der Schmetterlinge Europas, Tafel 4, fig. 22. (Nachtrag) 1904.

purpurea Hw., *Depressaria* Fam. *Gelechiidae*
Synonym—Coleophora vaccinella H.S.
Hosts—Vaccinium myrtillus, V. uliginosum, V. vitis-idaea.
Injury—Larvae feed on leaves in September and October.
Distribution—Southern and central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 418. 1874.

purpurissata Dru., *Polia* Fam. *Noctuidae*
(see page 171)

pustularia Hb., *Itame (Cymatophora)* Fam. *Geometridae*
Hosts—Blueberry.
Injury—Larvae feed on leaves.
Distribution—Atlantic States.
Reference—Felt, E. P. Insects affecting park and woodland trees. New York State Mus. Mem. 8, vol. 2, p. 738. 1906.

putata Linn., *Thalera (Jodis)* Fam. *Geometridae*
Hosts—Blueberry.
Injury—Larvae feed on foliage from mid-July to October.
Distribution—Northern and central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.

quinquecristatella Cham., *Telphusa* Fam. *Gelechiidae*
Hosts—Huckleberry.
Injury—Larvae feed on buds.
Distribution—Eastern North America.
Reference—Forbes, W. T. M. The Lepidoptera of New York and neighboring states. Cornell Agr. Expt. Sta. Mem. 68:292. 1923.

rectilinea Esp., *Hyppa* Fam. *Noctuidae*
Hosts—Blueberry.
Injury—Larvae feed on leaves.

Distribution—Northern and central Europe.
Reference—Spuler, A. Die Raupen der Schmetterlinge Europas, Tafel 28, fig. 1. 1904.

redimicula Morr., *Euxoa* Fam. *Noctuidae*
(see page 150)

ribearia Fitch., *Itame (Diastictis)* Fam. *Geometridae*
Hosts—Blueberry, currant, gooseberry and other plants.
Injury—Larvae feed on leaves.
Distribution—Atlantic States.
Reference—Mosher, Edna. Pupae of some Maine species of Notodontoidea. Maine Agr. Expt. Sta. Bul. 259:52. 1917.

rogana Gn., *Tortrix* Fam. *Tortricidae*
Synonym—*Tortrix lusana* H. S.
Hosts—Blueberry.
Injury—Larvae feed on leaves in June.
Distribution—Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 418. 1874.

rubifera Grt., *Agrotis* Fam. *Noctuidae*
(see page 161)

rumicis Linn., *Acronycta* Fam. *Noctuidae*
Hosts—Blueberry, euphrasy, heath, marsh-trefoil, oak, poplar, sorrel, willow.
Injury—Larvae feed on foliage.
Distribution—Palearctic region, Japan, and China.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 415. 1874.

rusticana Tr., *Tortrix* Fam. *Tortricidae*
Hosts—Blueberry.
Injury—Larvae feed on leaves.
Distribution—Northern and central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.

sauciana Hb., *Olethreutes (Penthina)* Fam. *Tortricidae*
Hosts—Blueberry.
Injury—Larvae feed on leaves in May.
Distribution—Europe including England.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 418. 1874.

serrata Dru., *Euchlaena* Fam. *Geometridae*
(see page 147)

solidaginis Hb., *Calocampa (Xylina)* Fam. *Noctuidae*
Hosts—*Vaccinium myrtillus, V. vitis-idaea.*
Injury—Larvae feed on plants in May and June.
Distribution—North America, northern and central Europe.
References—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.
Schoyen, T. H. (letter of March 19, 1929).

sordidata Fab., *Larentia* Fam. *Geometridae*
Synonym—*Cydaria elutata* Hb.
Hosts—*Vaccinium myrtillus* and willow.
Injury—Larvae feed on leaves in May.
Distribution—Europe.
References—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.
Spuler, A. Die Raupen der Schmetterlinge Europas, Tafel 46, fig. 25a. 1904.

subjuncta G. and R., *Polia* Fam. *Noctuidae*
(see page 173)

sulfureana Clem., *Sparganothis* Fam. *Tortricidae*
(see page 137)

tincta Brahm., *Polia (Mamestra)* Fam. *Noctuidae*
Hosts—Blueberry, *Ononis spinosa.*
Injury—Larvae feed on leaves.
Distribution—Northern and central Europe.
References—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 415. 1874.
Spuler, A. Die Raupen der Schmetterlinge Europas, Tafel 24, fig. 18. 1904.

trialbamaculella Cham., *Gelechia* Fam. *Gelechiidae*
Hosts—Epigaea, *Gaylussacia frondosa, G. baccata,* locust, oak, *Vaccinium pennsylvanicum, V. stamineum, V. vacillans.*
Injury—Larvae web leaves together and mine in tips of new growth.
Distribution—Maine to New Jersey, Virginia, and western Texas.
Reference—Franklin, H. J. Cape Cod cranberry insects. Massachusetts Agr. Expt. Sta. Bul. 239:16. 1928.

tristigmata Wlk., *Harrisimemna* Fam. *Noctuidae*
Hosts—Huckleberry and other plants.
Injury—Larvae feed on leaves and buds.
Distribution—Atlantic States.
Reference—Smith, J. B. Insects of New Jersey, p. 446. 1909.

tritona Hb., *Acronycta* Fam. *Noctuidae*
Hosts—Azalea, blueberry, cranberry, deerberry, and other plants.
Injury—Larvae feed on leaves and buds in May and September.

Distribution—Atlantic States.
Reference—Smith, J. B. Insects of New Jersey, p. 445. 1909.

truncata Hufn., *Larentia* Fam. *Geometridae*
Synonym—*Cidaria russata* Hb.
Hosts—Blueberry, plantain, woodbine.
Injury—Larvae feed on leaves.
Distribution—North America, northern and central Europe.
References—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.
Leonard, M. D. A list of the insects of New York. Cornell Agr. Expt. Sta. Mem. 101:594. 1926.

ulmana Hb., *Anisotaena (Olindia)* Fam. *Tortricidae*
Hosts—*Vaccinium myrtillus.*
Injury—Larvae feed on foliage.
Distribution—Central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 418. 1874.

unicornis S. and A., *Schizura* Fam. *Notodontidae*
(see page 179)

vacciniana Z., *Steganoptycha (Grapholitha)* Fam. *Tortricidae*
Hosts—Blueberry.
Injury—Larvae web leaves together and skeletonize them.
Distribution—Northern and central Europe.
References—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 418. 1874.
Sorauer, P. Handbuch der Pflanzenkrankheiten 3:287. 1913.

vacciniella Busck, *Dichomeris* Fam. *Gelechiidae*
Hosts—Cranberry, huckleberry, Vaccinium.
Injury—Larvae fold and feed on leaves.
Distribution—New Jersey.
Reference—Smith, J. B. Insects of New Jersey, p. 559. 1909.

vacciniella Ely, *Gracilaria* Fam. *Gracilariidae*
(see page 136)

vacciniella Zell., *Metriostola (Nephopteryx)* Fam. *Pyralididae*
Hosts—*Vaccinium myrtillus, V. uliginosum.*
Injury—Larvae feed on leaves.
Distribution—Finland and Prussia.
Reference—Romanoff, N. M. Memoires sur les Lepidopteres 7:478-479. 1893.

vaccinii (Riley), *Mineola* Fam. *Pyralididae*
Hosts—Dangleberry, huckleberry, *Pyrus Malus, Vaccinium corymbosum, V. vitis-idaea.*

Injury—Larvae feed on berries webbing several together.
Distribution—Maine, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Wisconsin, Texas, and Washington.
Reference—Franklin, H. J. Cape Cod cranberry insects. Massachusetts Agr. Expt. Sta. Bul. 239:54. 1928.

vaccinii Linn., *Orrhodia (Cerastis)* Fam. *Noctuidae*
Hosts—Blackberry, blueberry, cranberry, poplar, raspberry.
Injury—Larvae feed on leaves in May and June.
Distribution—Northern and central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 416. 1874.

velutinana Wlk., *Eulia* Fam. *Tortricidae*
Synonym—*Eulia triferana* Wlk.
Hosts—Huckleberry and many other plants.
Distribution—Atlantic States west to Illinois.
References—Forbes, W. T. M. The Lepidoptera of New York and neighboring states. Cornell Agr. Expt. Sta. Mem. 68:490. 1923.
Smith, J. B. Insects of New Jersey, p. 550. 1909.

viburniana F., *Tortrix* Fam. *Tortricidae*
Synonym—*Tortrix viburnana* SV.
Hosts—Juniperus, Ledum, *Pinus abies, P. sylvestris, Vaccinium uliginosum,* Viburnum.
Injury—Larvae feed between spun leaves in May and June.
Distribution—Northern and central Europe.
Reference—Kaltenbach, J. H. Die Pflanzenfeinde aus der Klasse der Insekten, p. 418. 1874.

walkeri Grt., *Scopelosoma* Fam. *Noctuidae*
(see page 174)

xylinoides Gn., *Hyppa* Fam. *Noctuidae*
(see page 176)

HYMENOPTERA

nubilipennis Ashm., *Hemadas* Fam. *Miscogasteridae*
Hosts—*Vaccinium corymbosum, V. pennsylvanicum.*
Injury—Forms pithy galls on stems.
Reference—Driggers, B. F. Galls on stems of cultivated blueberry *(Vaccinium corymbosum)* caused by a Chalcidoid, *Hemadas nubilipennis* Ashm. Jour. New York Ent. Soc. 35:253-259. 1927.

vaccinii Ashm., *Solenzophoria* Fam. *Cynipidae*
Hosts—High and low blueberry, huckleberry.

Injury—Thought to produce stem galls.
Distribution—Atlantic States south to Florida and District of Columbia.
Reference—Felt, E. P. Key to American insect galls. New York State Mus. Bul. 200:177. 1918.

Tenthredinidae
(see page 180)

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Fig. 17. A Blueberry Field in Washington County.

FIG. 18. A, Blueberries injured by stink bugs; B, cricket injury to blueberry fruit; C, oyster-shell scale on *Vaccinium hirsutum;* D, thrips injury to blueberry leaves. X 2.

FIG. 19. The Blueberry Maggott: A, Male fly; B, puparium; C, larva; D, larvae in blueberry fruit. enlarged.

FIG. 20. A, Leaves fastened together by *Sparganothis sulfureana;* B, work of *Gracilaria vaccinii* on blueberry leaves. X 2.

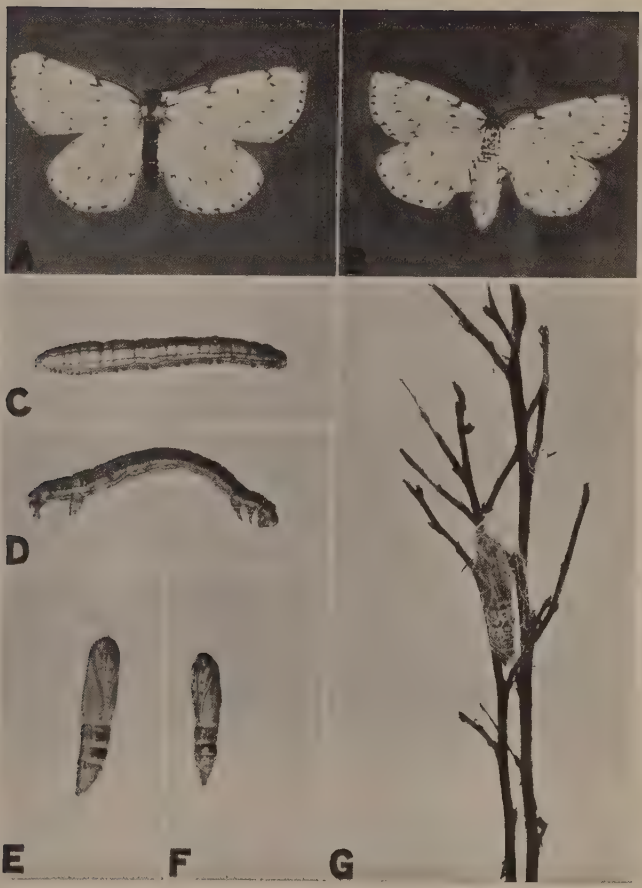
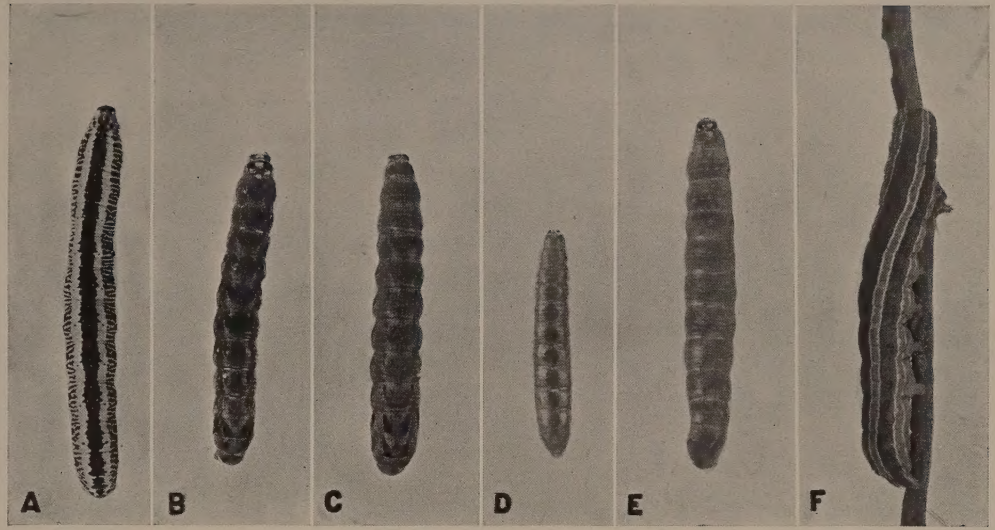


FIG. 21. Chain-dotted Geometer and Work: A and B, male and female moths; C and D, dorsal and side views of full grown caterpillar; E and F, female and male pupae; G, defoliated blueberry plant showing pupa in cocoon.

FIG. 22. A, Blueberry plant with uninjured fruit buds; B, blueberry plant with buds destroyed by cutworms.

BLUEBERRY CUTWORMS

FIG. 23. A, *Agrotis bicarnea;* B, *A. c-nigrum;* C, *A. fennica;* D, *A. phyllophora;* E, *Noctua clandestina;* F, *Lampra brunneicollis.*



BLUEBERRY CUTWORMS

FIG. 24. A, *Ceramica picta;* B, *Lycophotia astricta;* C, *L. occulta;* D, *Polia lorea;* E, *P. purpurissata;* F, *P. subjuncta.*